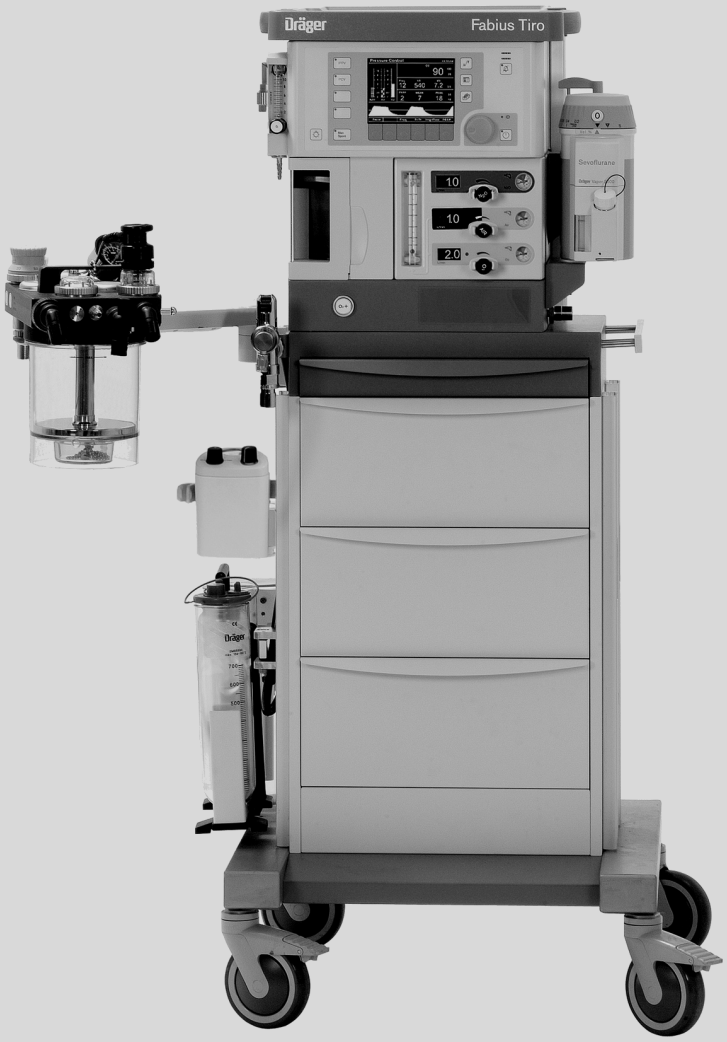
Dräger medical
A Dräger and Siemens Company

# Fabius® Tiro




## Inhalation Anesthesia Machine
## Software 3.0n
## Instructions for Use

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# For Your Safety and that of Your Patients

## Strictly follow the Instructions for Use

Any use of the apparatus requires full understanding and strict observation of these instructions. The apparatus is only to be used for purposes specified here.

## Maintenance

The apparatus must be inspected and serviced regularly by trained service personnel at six monthly intervals. Repair and general overhaul of the apparatus may only be carried out by trained service personnel.We recommend that a service contract be obtained with DrägerService and that all repairs also be carried out by them.Only authentic Dräger spare parts may be used for maintenance. Observe chapter “Routine Maintenance and Cleaning” on page 137.

## Accessories

Do not use accessory parts other than those in the attached accessory list (86 06 126, Rev. 00 or higher).

**Note:** Even accessories designed to be reused after cleaning have a limited life. Due to a number of factors connected with handling and preparation, disinfectant residues can attack the material more intensely during autoclaving; increased wear can occur and service life can be markedly shortened.

Such parts should be replaced when external signs of wear become apparent, such as cracks, deformation, discoloration, peeling, etc.

## Not for Use in Areas of Explosion Hazard

This apparatus is neither approved nor certified for use in areas where combustible or explosive gas mixtures are likely to occur.

## Safe Connection with Other Electrical Equipment

Electrical connections to equipment which are not listed in these Instructions for Use should only be made following consultations with the respective manufacturers or an expert.

**Note:** Systems must meet the requirements in accordance with IEC/EN 60601-1-1 and IEC/EN 60601-1-2.

**General information on electromagnetic compatibility (EMC) according to the international EMC standard IEC 60601-1-2: 2001**

Medical electrical equipment needs special precautions regarding electromagnetic compatibility (EMC) and needs to be installed and put into service according to the EMC information provided in the technical documentation available from DrägerService upon request.

Portable and mobile RF communications equipment can affect medical electrical equipment.

Pins of connectors identified with the ESD warning symbol shall not be touched and not be connected unless ESD precautionary procedures are used. Such precautionary procedures may include antistatic clothing and shoes, the touch of a ground stud before and during connecting the pins, or the use of electrically isolating and anti-static gloves. All staff involved in the above shall receive instruction in these procedures.

## Liability for Proper Function or Damage

The liability for the proper function of the apparatus is irrevocably transferred to the owner or operator to the extent that the apparatus is serviced or repaired by personnel not employed or authorized by DrägerService or if the apparatus is used in a manner not conforming to its intended use. Dräger cannot be held responsible for damage caused by noncompliance with the recommendations given above. The warranty and liability provisions of the terms of sale and delivery of Dräger are likewise not modified by the recommendations given above.
Dräger Medical AG & Co. KG

## Safety Features

- Monitoring of P, V, $FiO_2$
- $O_2$ SUPPLY LOW alarm
- Integrated S-ORC = Sensitive Oxygen Ratio Controller (control device to ensure minimum $O_2$ concentration of 23 Vol.%).

Per EN740, burns may occur if antistatic or electrically conductive ventilation tubes are used in combination with high-frequency electrical surgery equipment. Therefore, per EN740, these types of breathing tubes are not recommended.

**CAUTION !**
Do not use Fabius Tiro in the environment of NMR tomography equipment. Malfunctions may result, thereby endangering the patient.

### Safety Precautions

As per EN740 (Anesthetic Workstations and their Modules - Particular Requirements), additional monitoring of the concentrations of $CO_2$ and anesthetic agent is required when the machine is in use.

**Do not use readily flammable anesthetic agents such as ether, cyclopropane, etc.**

**Drugs or other substances based on inflammable solvents, such as alcohol, must not be introduced into the patient system.**

**Risk of fire.**

**Adequate ventilation must be ensured if highly inflammable substances are used for disinfection.**

## Copyright and Trademark

### Copyright

Copyright 2005 by Dräger. All rights reserved. No part of this publication may be reproduced, transmitted, transcribed, or stored in a retrieval system in any form or by any means, electronic or mechanical, including photocopying and recording, without written permission of Dräger. The exceptions to this are “Disinfecting/Cleaning/Autoclaving” on page 142, and “Daily and Preuse Checkout Form” in the Appendix.

### Trademark Notices

DrägerService and Vitalink are registered trademarks of Dräger. Fabius and Vapor are registered trademarks of Dräger. Selectatec is a registered trademark of Datex-Ohmeda. All other products or brand names are trademarks of their respective owners.

## Intended Use

**Fabius® Tiro is an inhalation anesthesia machine for use in operating, induction and recovery rooms.**

It may be used with $O_2$, $N_2O$, and AIR supplied by a medical gas pipeline system or by externally mounted gas cylinders.

Fabius Tiro is equipped with a compact breathing system, providing fresh gas decoupling, PEEP, and pressure limitation.

The following ventilation options are available:

- Volume Controlled Ventilation (IPPV)
- Pressure Controlled Ventilation (PCV) (Optional)
- Pressure Support (PS) (Optional)
- SIMV/PS (Optional)
- Manual Ventilation (MAN)
- Spontaneous Breathing (SPONT)

Fabius Tiro is equipped with an electrically driven and electronically controlled ventilator and monitors for airway pressure (P), volume (V), and inspiratory oxygen concentration ($FiO_2$).

**Note:** "$O_2$ Monitoring Disabled" is a DrägerService-configurable option. See "O2 Monitoring Disabled" on page 92 for more information. In this case, external $FiO_2$ monitoring must be available.

### Medibus Protocol

Software protocol for use in transferring data between the Fabius and an external medical or non-medical device (e.g. hemodynamic monitors, data management systems, or a windows-based computer) via the RS 232 Interface (See 9038530_2).

**Data transferred via MEDIBUS interfaces are for information only an are not intended as a basis for diagnosis or therapy decisions.**

**In order to protect patients und users from electrical hazards it is imperative that all systems consisting of electrical medical devices and other devices such as but not limited to PCs, Printers, etc. be mounted exclusively by trained personnel.**

The system must meet the requirements about medical electrical equipment in accordance to IEC/EN 60601-1-1 and IEC/EN 606061-1-2.

## Symbol Definition

The following symbols appear on the labels on the back of the Fabius Tiro and are defined below.

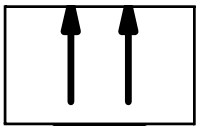
**Caution:** Refer to accompanying documents before operating equipment.

CSA Test Mark

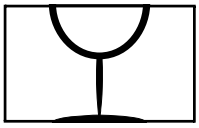
Year Manufactured

The following symbols appear on the shipping container of the Fabius Tiro.

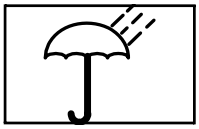
This end up.



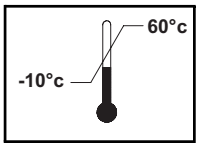
Handle with care.



Keep dry.



Minimum and maximum storage temperatures.



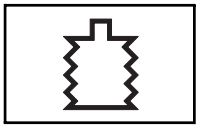
The following symbols are used on other locations of the Fabius Tiro to provide quick and easy recognition of product functions.

Oxygen Concentration Sensor Port

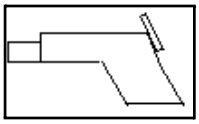
Breathing Pressure Sensor Port

Breathing Volume Sensor Port

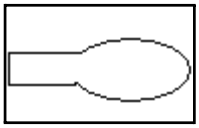
Ventilator Port



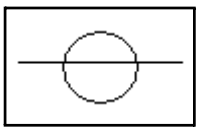
Pipeline, Gauge, Pipeline Inlet



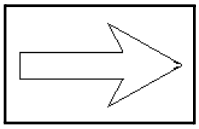
Breathing Bag



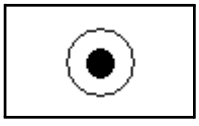
Flowmeter Level Indicator



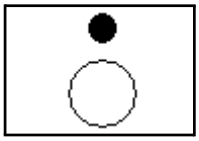
Indicates Direction



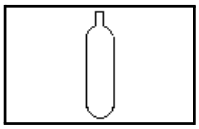
Total Power Applied



Partial Power Applied



Cylinder Gauge, Remote Cylinder Inlet

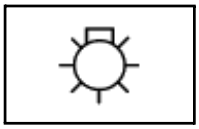


Do Not Oil

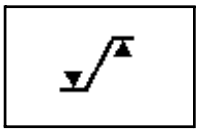
Do Not Use $O_2$ Cylinder In This Position

The following symbols are used on the Fabius Tiro monitoring user interface.

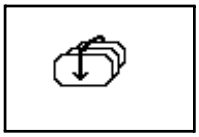
Table Top Light



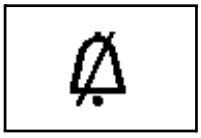
Upper and Lower Alarm Limits



Return to Home Screen

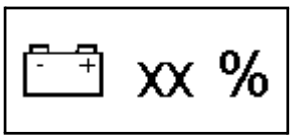


Suppress Alarm Tone for Two Minutes

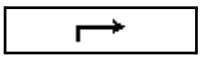


Standby Mode

Available Operating Capacity of UPS




Close Menu, Back to Previous Menu



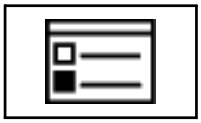
Upper Alarm Limit

Lower Alarm Limit

Mains Power

Alarm Off

Setup Screen

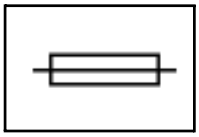


In addition to symbols already described, the following symbols appear on the optional Heated Breathing System Power Supply (HBSPS).

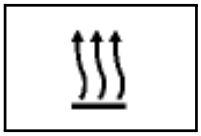
**Caution:** Risk of electric shock, do not remove cover. Refer servicing to a DrägerService representative.

Degree of protection against electric shock: Class 1 Type B.

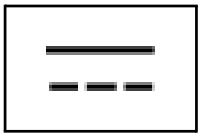
Fuse



Heater Power



DC Voltage



AC Voltage

# Abbreviations

| Abbreviation | Meaning |
|---|---|
| COSY | Compact breathing system |
| FLOW | Expiratory flow |
| $FiO_2$ | Inspiratory $O_2$ concentration |
| Freq | Ventilation frequency |
| Freq Min | Minimum ventilation frequency setting for Pressure Support Apnoea Ventilation |
| MAN | Manual ventilation |
| MEAN | Mean (airway) pressure |
| $N_2O$ | Nitrous Oxide |
| $O_2$ | Oxygen |
| PAW | Airway pressure |
| PEAK | Peak (airway) pressure |
| PEEP | Positive end-expiratory pressure |
| PINSP | Pressure setting in Pressure Control mode or the sum of ΔPPS and PEEP settings in Pressure Support mode |
| PLAT | Plateau airway pressure |
| Pmax | Maximum (airway) pressure setting |
| Δ PPS | Pressure support setting in Pressure Support mode or SIMV/PS mode |
| SIMV | Synchronized Intermittent Mandatory Ventilation |
| SPONT | Spontaneous breathing |
| TI:TE | Ratio of inspiratory to expiratory time |
| Tip:Ti | Ratio of inspiratory pause time to inspiratory time |
| UPS | Uninterruptible power supply |
| VAC | Vacuum (e.g., for secretion aspiration) |
| VT | Tidal volume |

## General Warnings and Cautions

The following list of warnings and cautions apply to general operation and maintenance of the Fabius Tiro. Warnings and cautions about installing and operating specific parts appear with those topics.

- Warning statements give important information that, if ignored, could lead directly to a patient's or operator's injury.
- Caution statements give important information that, if ignored, could lead directly to equipment damage and, indirectly, to a patient's injury.

**WARNING !**

Any person involved with the setup, operation, or maintenance of the Fabius Tiro anesthesia system must be thoroughly familiar with this instruction manual.

**WARNING !**

This anesthesia system will not respond automatically to certain changes in patient condition, operator error, or failure of components. The system is designed to be operated under the constant surveillance and control of a qualified operator.

**WARNING !**

No third-party components shall be attached to the anesthesia machine, ventilator, or breathing system (except for certain approved exceptions). For more information, contact DrägerService.

**WARNING !**

Each institution and user has a duty to independently assess, based on its, his, or her unique circumstances, what components to include in an anesthesia system. However, Dräger, in the interest of patient safety, strongly recommends the use of an oxygen analyzer, pressure monitor, volume monitor, and end-tidal $CO_2$ monitor in the breathing circuit at all times.

**WARNING !**

Exercise special care so that the machine does not tip when moving up or down inclines, around corners, and across thresholds (for example, in door frames and elevators). Do not attempt to pull the machine over any hoses, cords, or other obstacles on the floor.

**WARNING !**

Apply the caster brakes when the anesthesia machine is in use.

**WARNING !**

Do not place third-party components on top of the Fabius Tiro monitor housing. Only components approved by Dräger may be used.

**WARNING !**

Route all lines/cables away from the APL valve to prevent interference with the APL valve adjustment knob. Lines/cables caught underneath the APL valve adjustment knob could interfere with proper functioning of this valve.

**WARNING !**

**Warning:** When the moisture content falls below a specified minimum level, the following undesirable reactions can occur, regardless of the type of $CO_2$ absorbent and the anesthetic agent used, e.g. Halothane, Enflurane, Isoflurane, Sevoflurane or Desflurane:

- reduced $CO_2$ absorption,
- formation of CO,
- absorption and/or decomposition of the inhalation anesthetic agent,
- increased heat generation in the absorber, leading to higher breathing gas temperatures.

Additionally, the breakdown products of anesthetic agents exposed to dry absorbent are both flammable and toxic, and fires have been reported in association with the use of desiccated absorbent and volatile anesthetics.

These reactions can result in danger to the patient in the form of CO intoxication, insufficient depth of anesthesia and airway burns.

**CAUTION !**
Risk of electric shock, do not remove cover. Refer servicing to a DrägerService representative.

**CAUTION !**
Although the Fabius Tiro is designed to minimize the effects of ambient radio-frequency interference, machine functions may be adversely affected by the operation of electrosurgical equipment or short wave or microwave diathermy equipment in the vicinity.

**CAUTION !**
Communications with external equipment may be temporarily affected by electromagnetic interference due to the use of electrosurgical equipment.

**CAUTION !**
Do not place more than 18 kilograms on top of the Fabius Tiro monitor housing.

**CAUTION !**
Do not place more than 10 kilograms on top of the Fabius Tiro optional writing tray.

**CAUTION !**
Never allow the battery to completely discharge. If the battery does discharge completely, recharge immediately.

**CAUTION !**
Front GCX rails have a maximum accessories weight load of 5 lb./2.3 kg, extended out at 3 in./7.6 cm from the rail, at any position on the rail.

**CAUTION !**
Only the combinations approved by Dräger, with monitoring and the correspondingly defined assembly parts, may be used.

**CAUTION !**
Do not place more than 15 pounds (6.8 kilograms) in any drawer.

**CAUTION !**
Trolley mounted units with left hand COSY: the combined weight of the accessories shall not exceed 30 pounds (13.6 kilograms) on the side of the Fabius Tiro where the COSY is mounted, and shall not exceed 40 pounds (18.2 kilograms) on the side opposite the COSY.

# Configurations and Components

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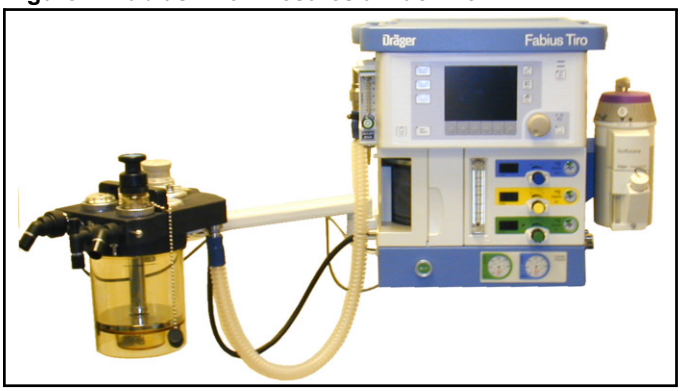
# Typical Fabius Tiro Configuration

The Fabius Tiro Inhalation Anesthesia Machine is a modular system consisting of a basic gas-delivery module with a variety of components and configuration designs to meet the requirements of various anesthesia delivery applications.

- 2-gas version ($O_2$ and Air)
- 3-gas version ($O_2$, $N_2O$, and Air)
- pin index cylinder yokes and pressure gauges
- Euro-cylinder connectors

**Figure 1. Fabius Tiro Anesthesia Machine**




# Components

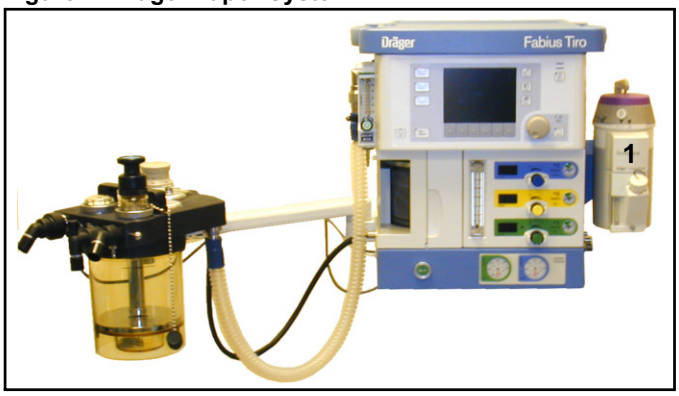
## Vaporizer (Optional)

The Dräger Vapor® anesthetic agent vaporizers (**1** in Figure 2) are used to enrich the fresh gas with a precisely metered quantity of vapor from the liquid anesthetic agent being used, i.e. Isoflurane, Halothane, Enflurane, or Sevoflurane.
When using a third-party Desflurane vaporizer:

| | |
|---|---|
| 220 V Mains | Devapor* |
| 110 V Mains | D-Tec* |
| 230 V Mains | D-Vapor |

* Devapor and D-Tec are available through your local Desflurane representative.

**Figure 2. Dräger Vapor System**

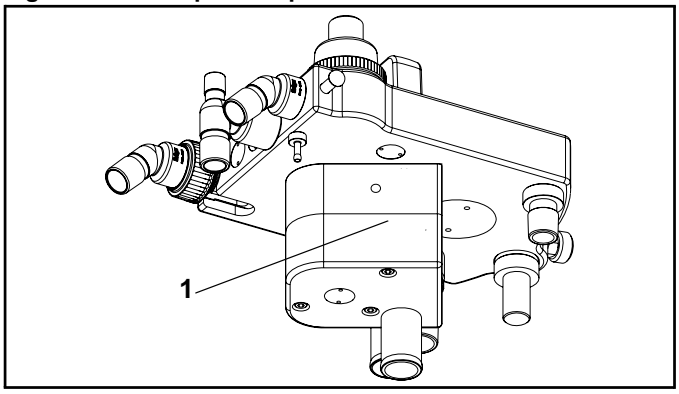



## Semi-Open Adapter

The semi-open compact breathing system is configured with a semi-open adapter (**1** in Figure 3) to perform as a semi-open system with no rebreathing.

The breathing system is used in the same way as the compact breathing system except that the $CO_2$ absorbent is not used. The fresh gas flow rate must be adjusted higher than the patient's minute volume.

**Figure 3. Semi-Open Adapter**




## Heated Breathing System (Optional)

The Fabius Tiro can be configured with an optional heated breathing system to reduce condensation of moisture in the system. See "Installation of HBSPS (Optional)" on page 60 for installation instructions.

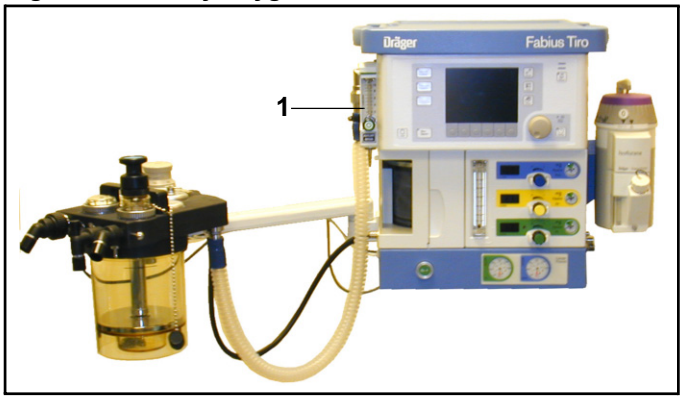
## Selectatec® (Optional)

The interlock system for the Selectatec is built into the vaporizers. When a vaporizer is selected for use, the interlocking index pins will protrude from the sides of the vaporizer thereby not allowing the neighboring vaporizer to be opened. For more specific information on the Selectatec, refer to the Selectatec Vaporizer's instruction manual.

## Auxiliary Oxygen Flowmeter (Optional)

For the delivery of a metered flow of pure oxygen (for example, delivery of oxygen through a nasal cannula), an optional auxiliary oxygen flowmeter (**1** in Figure 4) can be mounted on the left side of the flowmeter bank. This flowmeter can be used when the machine is turned off. A zero stop prevents damage to the flow control valve seat.

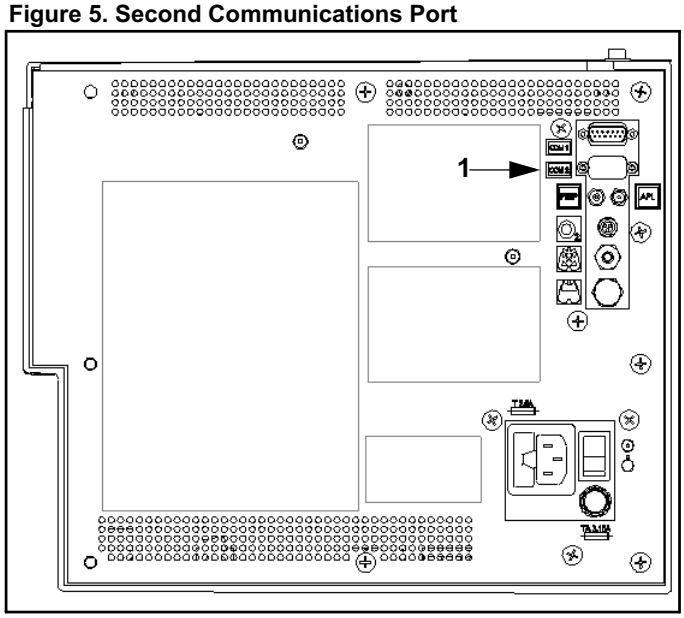
**Figure 4. Auxiliary Oxygen Flowmeter**



## Second Communications Port (Optional)

The Fabius Tiro can be configured with a second communications port that, like the standard communications port, supports Vitalink and Medibus communications (**1** in Figure 5).

**Figure 5. Second Communications Port**

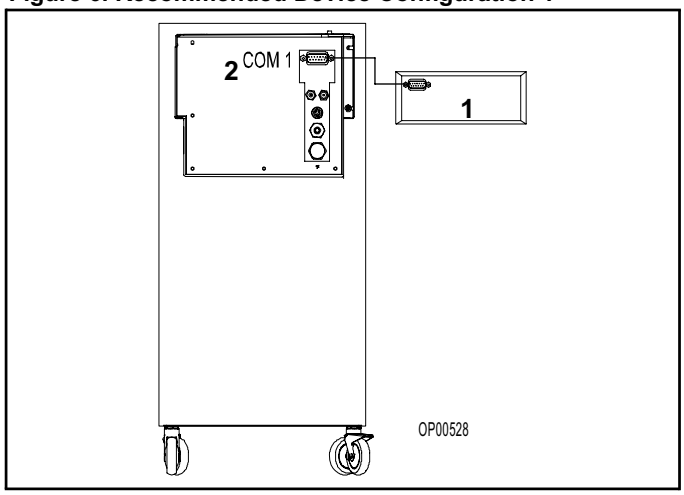



### Recommended Device Configurations

Fabius Tiro with One COM Port
Gas Analyzer with One COM Port

Connect gas analyzer (**1** in Figure 6) to Fabius Tiro COM1 (**2** in Figure 6).

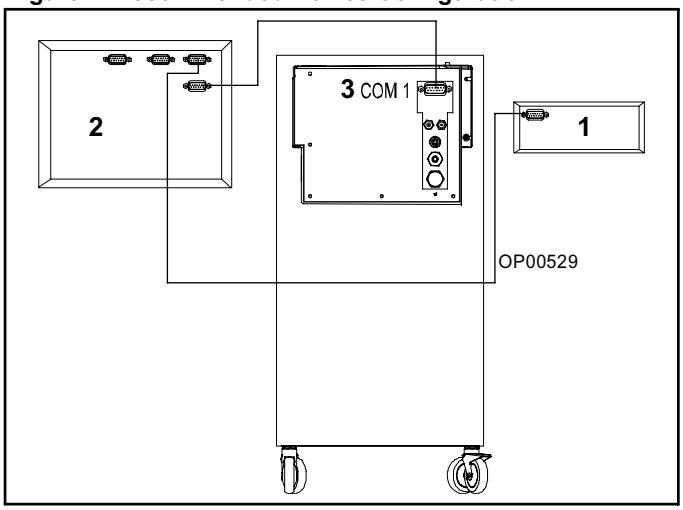
**Figure 6. Recommended Device Configuration 1**



Fabius Tiro with One COM Port
Gas Analyzer with One COM Port
Automatic Anesthesia Record Keeper

1. Connect gas analyzer (**1** in Figure 7) to anesthesia record keeper (**2** in Figure 7).
2. Connect anesthesia record keeper to Fabius Tiro COM1 (**3** in Figure 7).

**Figure 7. Recommended Device Configuration 2**

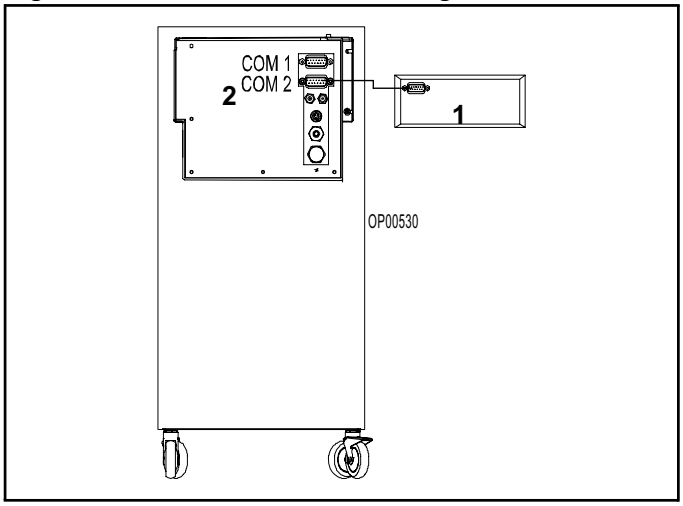



Fabius Tiro with Two COM Ports
Gas Analyzer with One COM Port

Connect gas analyzer (**1** in Figure 8) to Fabius Tiro COM2 (**2** in Figure 8).

**Note:** Data Pass Through (gas analysis data) must be enabled by DrägerService.

**Figure 8. Recommended Device Configuration 3**

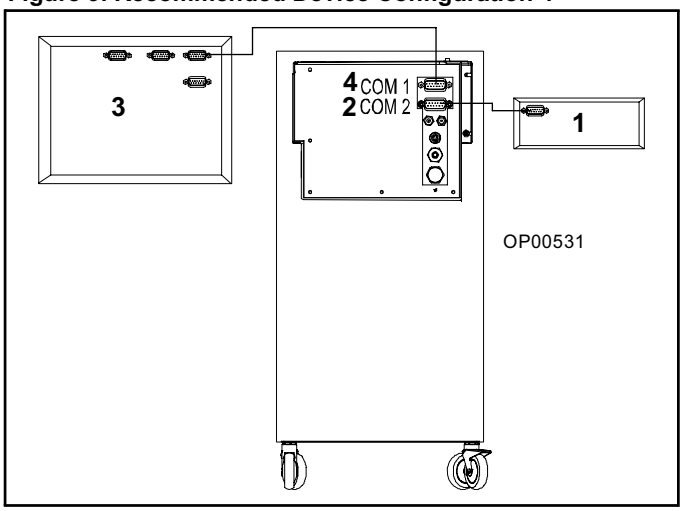



Fabius Tiro with Two COM Ports
Gas Analyzer with One COM Port
Automatic Anesthesia Record Keeper

1. Connect gas analyzer (**1** in Figure 9) to Fabius Tiro COM2 (**2** in Figure 9).
2. Connect anesthesia record keeper (**3** in Figure 9) to Fabius Tiro COM1 (**4** in Figure 9).

**Note:** Data Pass Through (gas analysis data) must be enabled by DrägerService.

**Figure 9. Recommended Device Configuration 4**

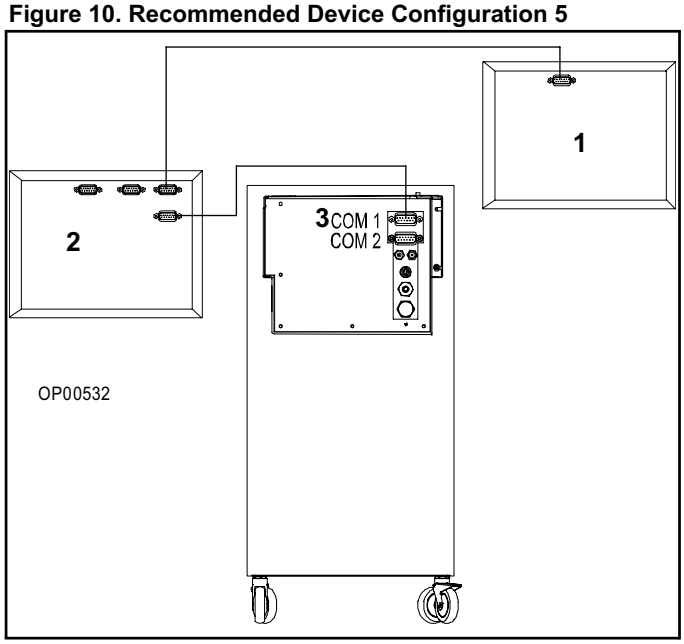


Fabius Tiro with One or Two COM Ports
Multi Parameter Monitor with One COM Port
Automatic Anesthesia Record Keeper

1. Connect monitor (**1** in Figure 10) to anesthesia record keeper (**2** in Figure 10).
2. Connect anesthesia record keeper to Fabius Tiro COM1 (**3** in Figure 10).

**Note:** Data Pass Through (gas analysis data) must be disabled by DrägerService.

**Figure 10. Recommended Device Configuration 5**

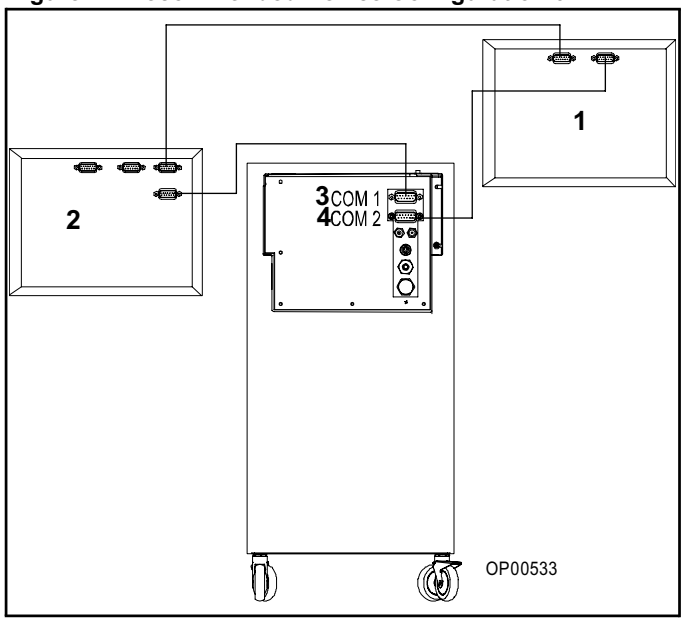



Fabius Tiro with Two COM Ports
Multi Parameter Monitor with Two COM Ports
Automatic Anesthesia Record Keeper

1. Connect monitor (**1** in Figure 11) to anesthesia record keeper (**2** in Figure 11).
2. Connect anesthesia record keeper to Fabius Tiro COM1 (**3** in Figure 11).
3. Connect monitor (**1** in Figure 11) to Fabius Tiro COM2 (**4** in Figure 11).

**Note:** Data Pass Through (gas analysis data) must be disabled by DrägerService.

**Figure 11. Recommended Device Configuration 6**



# Operating Concept

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## Overview

This chapter provides an overview of the user interface, which enables you to set and view monitoring, ventilation, and status information using the respective screens, windows, keys, soft keys, and the rotary knob. See “Monitoring” on page 89 for more information.

## Standard Function Controls

### Home Key

The Home key (**1** in Figure 12) displays the main screen (the screen in Figure 12) from anywhere in the system.

### Mains Power Applied LED

The Mains Power Applied LED (**2** in Figure 12), when illuminated, indicates that the machine is connected to a Mains power source.

### Selecting and Confirming

The rotary knob (**3** in Figure 12) is used to select and confirm functions by:

- Turning (Select)

  Turning the rotary knob

  - moves the cursor over the system operating parameters or
  - changes the value of a parameter that has been confirmed for adjustment.

  **Note:** This function is indicated in the examples and instructions of this manual by “select”.

- Pressing (Confirm)

  Pressing the rotary knob either

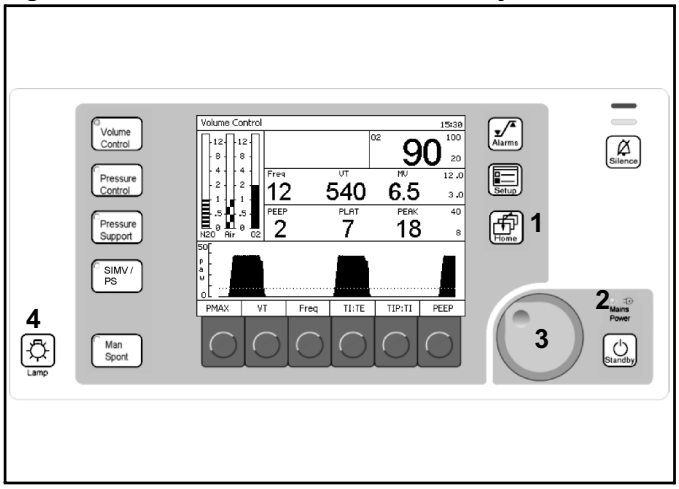
  - confirms the system operating parameter to be adjusted or
  - confirms the change to the selected operating parameter.

  **Note:** This function is indicated in the examples and instructions of this manual by “confirm”.

### Tabletop Light Key

The Tabletop Light key (**4** in Figure 12) turns on the tabletop light.

**Figure 12. Ventilation Monitor Screen and System Controls**



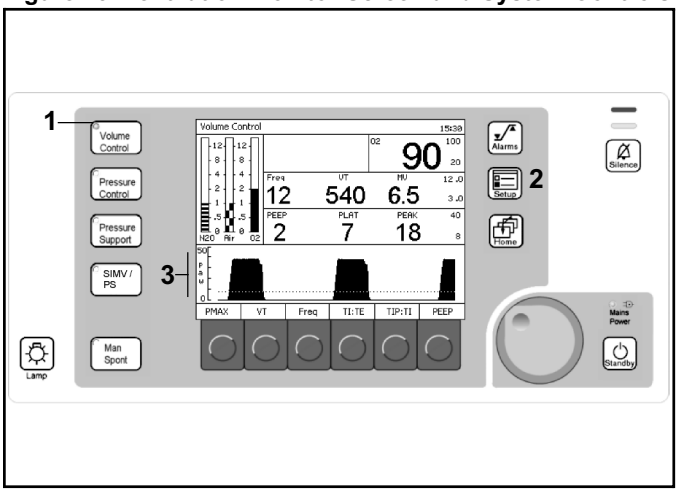
# Cross-Functional Controls and Displays

Cross-functional controls and displays are used for both monitoring and ventilation functions.

## Key LED Indicators

LED indicators (**1** in Figure 13) within keys (Volume Control, Pressure Control, Pressure Support, SIMV/PS, Man/Spont, Alarm Silence, and Standby) illuminate when that mode or function is selected and operating.

**Figure 13. Ventilation Monitor Screen and System Controls**




## Setup Key

The Setup key is **2** in Figure 13.

### Pressed During A Ventilation Mode

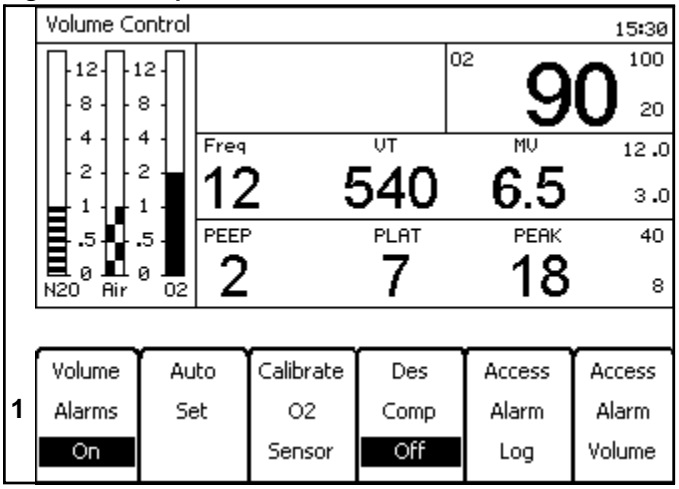
The Setup window (**1** in Figure 14) replaces the Waveform area (**3** in Figure 13).

The Setup window enables you to

- perform ventilation functions and
- view and change monitoring settings.

**Note:** The Volume Alarms On/Off soft key label does not appear in ManSpont mode because it is selectable on the ManSpont screen (Figure 32 on page 35).

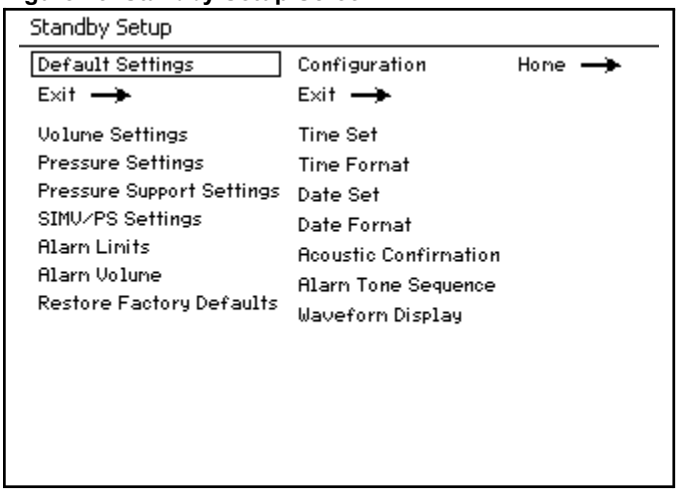
**Figure 14. Setup Window**




### Pressed During Standby Mode

The Standby Setup screen (Figure 15) appears. The Standby Setup screen enables you to define site defaults and configuration.

**Figure 15. Standby Setup Screen**



## Status Bar

The following numbers in parenthesis refer to Figure 16.

### Mode Display (1)

Displays the active ventilator mode.

### Alarm Silence Status (2)

Displays the time remaining for alarm silence when the Silence Alarms key is pressed.

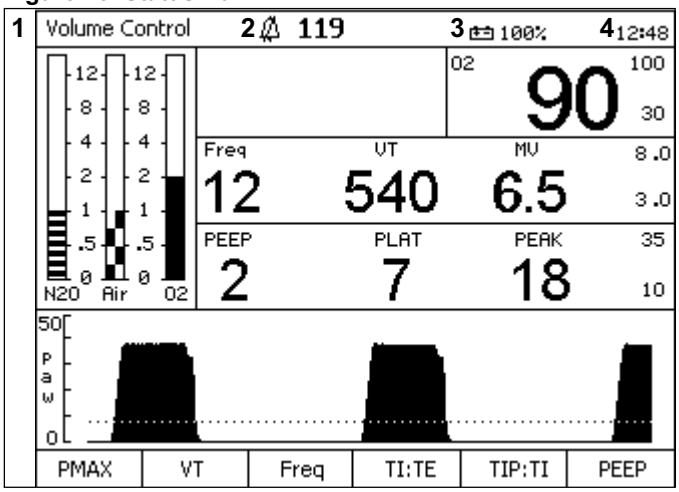
### Battery Power Level (3)

Displays the status of the reserve power.

### Time (4)

Displays the time.

**Figure 16. Status Bar**



# Monitoring

## Monitoring Controls

### LED Indicators

LED lamps (**1** in Figure 17) in the upper right corner of the control panel indicate the degree of urgency of currently active alarms.

- Warning – Red Blinking
- Caution – Yellow Blinking
- Advisory – Yellow Continuous

### Silence Alarms Key

The Silence Alarms key (**2** in Figure 17) silences all active alarm tones for 2 minutes. It resets the silence time for two minutes each time the key is pressed.

### Alarm Limit Key

The Alarm Limit key (**3** in Figure 17) displays the Alarm Limits window (**1** in Figure 18), which appears in the same location on all mode screens.

### Setup Key

The Setup key (**4** in Figure 17) is a cross-functional control. See “Setup Key” on page 24.

**Figure 17. Ventilation Monitor Screen and System Controls**

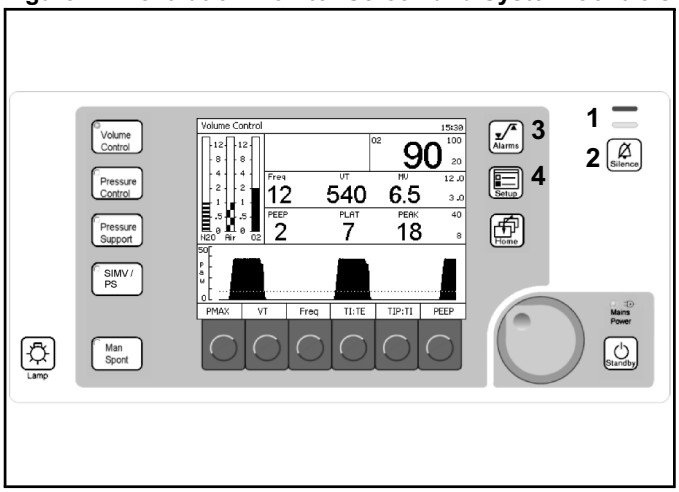
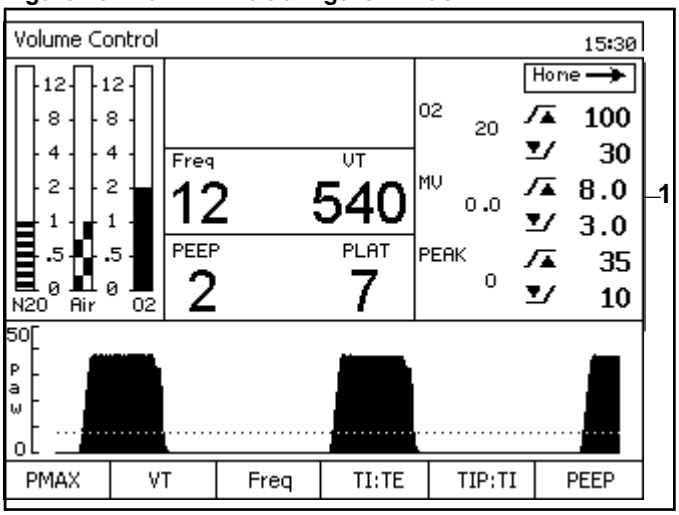



**Figure 18. Alarm Limit Configure Window**



## Monitoring Windows

The following numbers in boldface refer to Figure 19.

### Alarm Window

The Alarm window (**1**) displays up to four of the highest priority alarms.

### Oxygen Monitor Window

The Oxygen Monitor window (**2**) displays the inspiratory oxygen concentration in units of percent (%). It also displays the oxygen alarm limits in the far-right section of this window.

**Note:** "$O_2$ Monitoring Disabled" is a DrägerService-configurable option. See "O2 Monitoring Disabled" on page 92 for more information.

### Respiratory Volume Monitor Window

The Respiratory Volume Monitor window (**3**) displays the patient's frequency (breaths per minute) or respiratory rate, tidal volume, minute volume, the minute volume high alarm limit, and the minute volume low alarm limit.

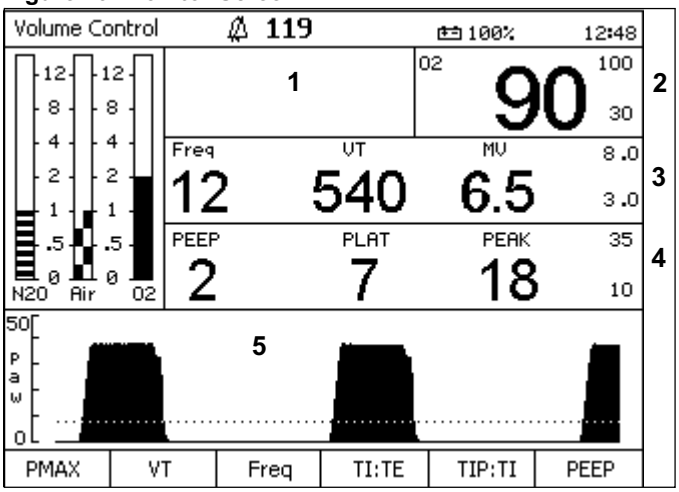
### Breathing Pressure Monitor Window

The Breathing Pressure Monitor window (**4**) displays the patient's positive end expiratory pressure (PEEP), mean airway pressure (MEAN) or plateau airway pressure (PLAT), and peak airway pressure (PEAK).

### Breathing Pressure Trace Window

The Breathing Pressure Trace window (**5**) displays a trace, or waveform, of the patient's breathing pressure.

**Figure 19. Monitor Screen**



## Selecting/Setting Monitoring Functions

The following example describes changing alarm limits on the Standby Setup Screen.

### Example

1. Press the Setup key while the Standby Screen (Figure 20) is active. The Standby Setup screen (Figure 21) replaces the Standby Screen.
2. The rotary knob enables you to select the “Default Settings” or “Configuration” label. Select and confirm the “Default Settings” label.

   The Default Settings column is selected (Figure 22).

**Note:** Selecting and confirming the return arrow (**1** in Figure 21) will deactivate the Standby Setup screen and activate the Standby screen (Figure 20).

**Note:** Selecting and confirming the return arrow (**1** in Figure 22) will deselect the Default Settings column and reselect the Default Settings label as in Figure 21.

**Figure 20. Standby Screen**

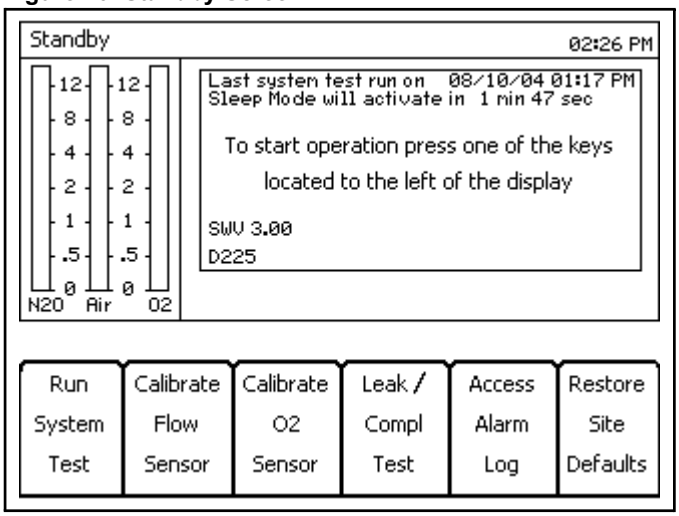



**Figure 21. Standby Setup Screen**

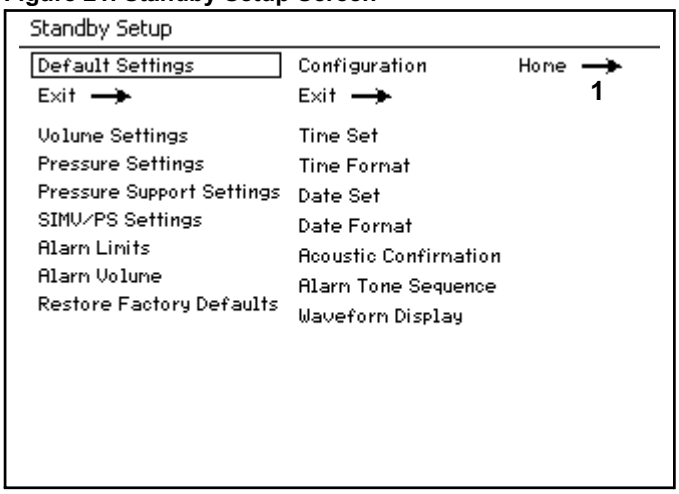
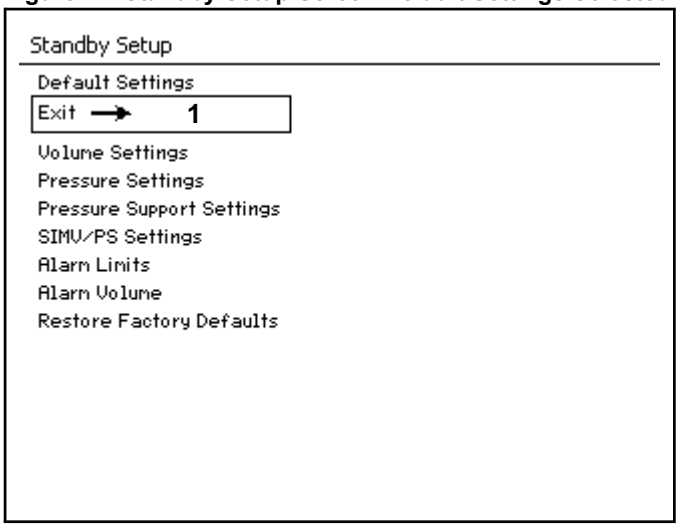


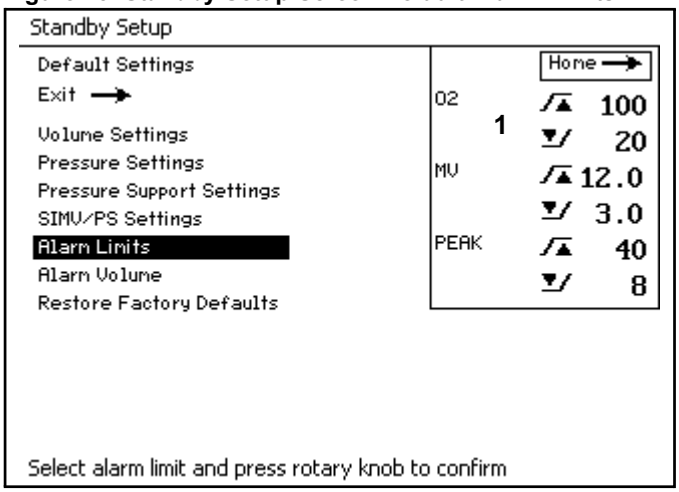

**Figure 22. Standby Setup Screen Default Settings Selected**



3. Select and confirm the “Alarm Limits” label.

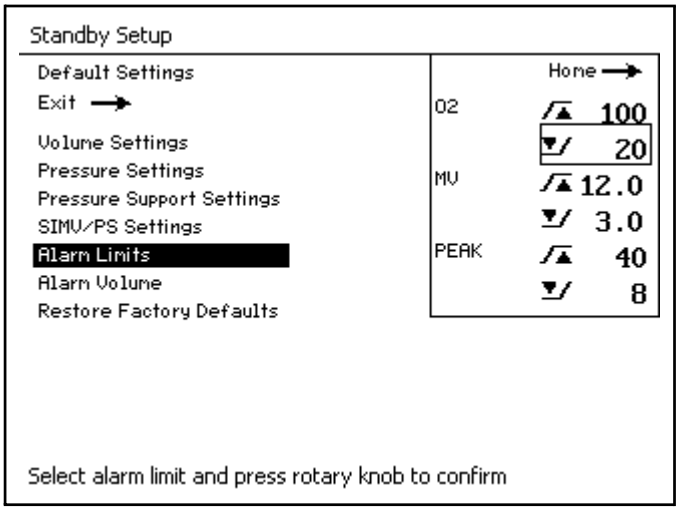
   The Default Alarm Limits window appears (**1** in Figure 23).

**Figure 23. Standby Setup Screen Default Alarm Limits**




4. Select the alarm limit value that needs to change (Figure 24).

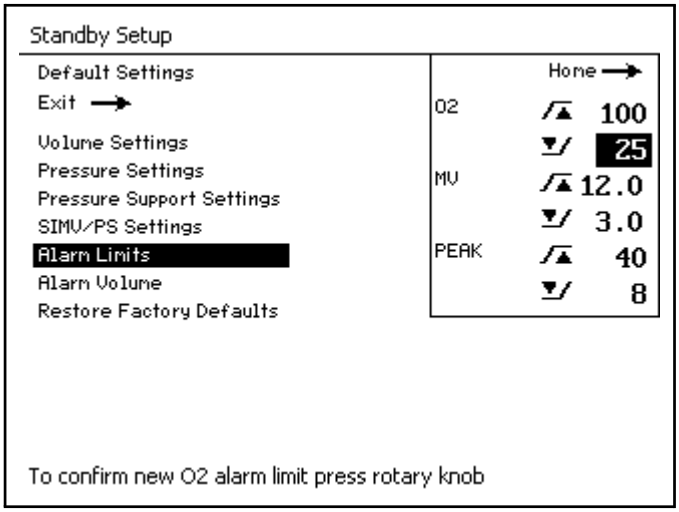
**Figure 24. Standby Setup Screen Default Alarm Limits Select**




5. Confirm the alarm limit value and select a new value for the alarm limit (ex., in Figure 25, the value was changed from 20 to 25).
6. Confirm the new value for the alarm limit.

   The new alarm limit value is saved and the cursor moves over the return arrow.

**Figure 25. Standby Setup Screen Default Alarm Limits Confirm**



# Ventilation

**Note:** Pressure Control, Pressure Support, and SIMV/PS, described in this manual, is optional.

## Ventilation Controls

The following numbers in boldface refer to Figure 26.

### Ventilation Mode Keys

Ventilation modes are selected by pressing one of the ventilation mode keys (**1**, **2**, **3**, **4**, **5**) and are confirmed by pressing the rotary knob. If the selection is not confirmed, the ventilation mode will not change.

### Standby Key

The Standby key (**7**) switches the ventilator to standby mode.

Monitoring and alarms are turned off and the ventilator stops.

### Setup Key

The Setup key (**6**) is a cross-functional control. See “Setup Key” on page 24.

### Soft Keys

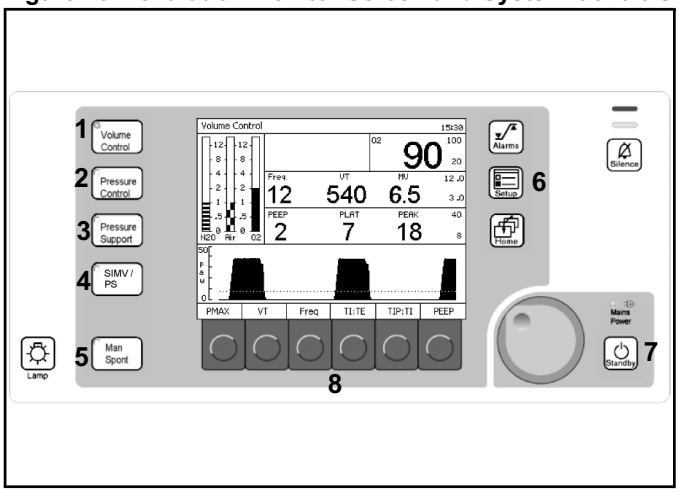
Soft keys (**8**) select ventilation parameters and functions.

## Ventilator Compliance Compensation

Ventilator compliance compensation is continuously applied during Volume Control so that the tidal volume delivered to the patient corresponds to the VT setting. Ventilator compliance is determined during the leak and compliance test performed from the Standby mode. To have compliance compensation work accurately, it is important that the patient hoses used during the leak/compliance test match the type of hoses used during the procedure.

**Note:** When the ventilator settings for Volume Control cause the ventilator to operate at its limits of performance, it is not possible for the Fabius Tiro to apply compliance compensation. If the ventilator's performance limit is reached, it is not possible to increment the Vt setting via the Volume Control Settings window.

**Figure 26. Ventilation Monitor Screen and System Controls**



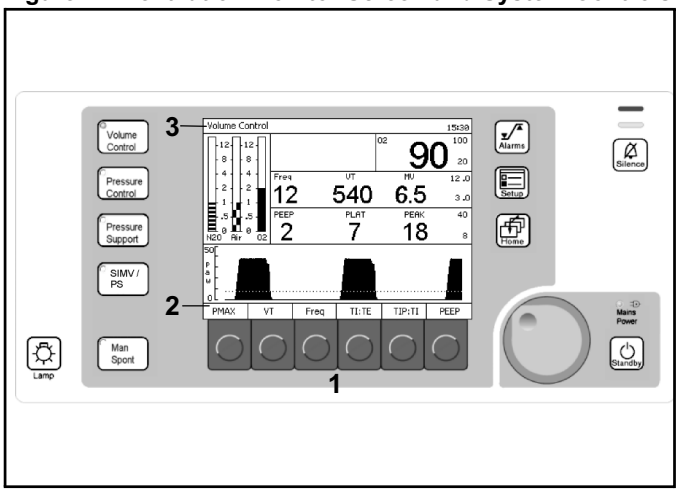
## Ventilation Screens

### Soft Key Labels

The following numbers in boldface refer to Figure 27.

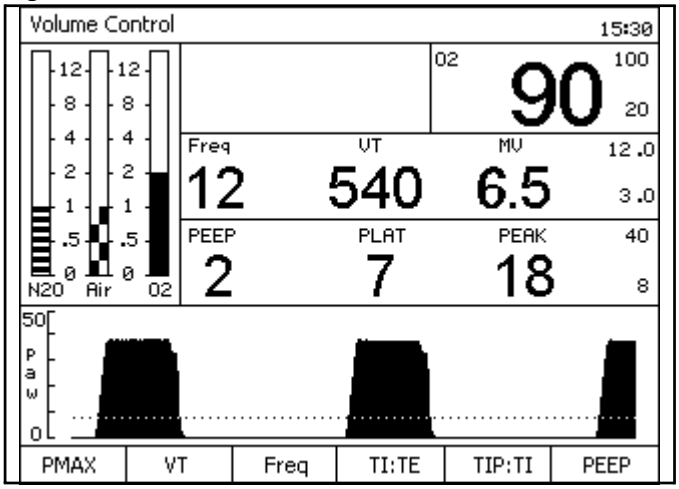
Each soft key (**1**) is associated with a ventilation parameter (**2**) that is associated with a specific ventilation mode (**3**).

**Figure 27. Ventilation Monitor Screen and System Controls**




Volume Control Mode (IPPV)
The following soft key labels appear from left to right along the bottom of the Volume Control screen. See Figure 28.

**Figure 28. Volume Control Ventilation Screen**




- **PMAX** (maximum ventilation pressure).
  The range for PMAX is
  15 to 70 cmH2O (mbar, hPa).
  **The factory default value is**
  **40 cmH2O (mbar, hPa).**
  (PMAX setting must be at least 10 cmH2O above PEEP)
- **VT** (tidal volume).
  The range for VT is 20 mL to 1400 mL.
  **The factory default value is 600 mL.**
- **Freq** (ventilation frequency).
  The range for Frequency is 4 bpm to 60 bpm.
  **The factory default value is 12 bpm.**
- **TI:TE** (time ratio between inspiration time and expiration time phases).
  The range for TI:TE is 4:1 to 1:4.
  **The factory default value is 1:2.**
- **TIP:TI** (relative inspiratory pause).
  The range for TIP:TI is 0% to 50%.
  **The factory default value is 10%.**
- **PEEP** (positive end expiratory pressure).
  The range for PEEP is
  0 to 20 cmH2O (mbar, hPa).
  **The factory default value is**
  **0 cmH2O (mbar, hPa).**

Pressure Control Mode (PCV)
The following soft key labels appear from left to right along the bottom of the Pressure Control screen. See Figure 29.

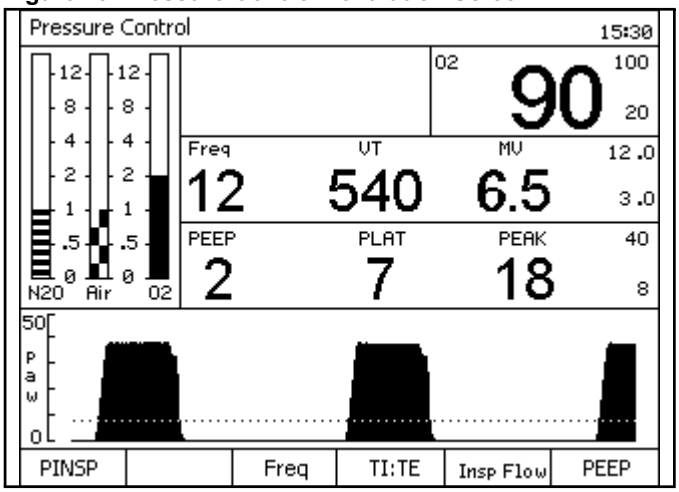
- **PINSP** (inspiratory pressure setting).
  The range for PINSP is
  5 to 65 $cmH_2O$ (mbar, hPa).
  **The factory default value is 15.**
  (PINSP setting must be at least 5 $cmH_2O$ above PEEP)
- **Freq** (ventilation frequency).
  The range for Frequency is 4 bpm to 60 bpm.
  **The factory default value is 12 bpm.**
- **TI:TE** (time ratio between inspiration and expiration phases).
  The range for TI:TE is 4:1 to 1:4.
  **The factory default value is 1:2.**
- **Insp Flow** (maximum rate at which the piston travels upward to create the target pressure).
  The range for Insp Flow is
  10 L/min to 75 L/min.
  **The factory default value is 30 L/min.**
- **PEEP** (positive end expiratory pressure).
  The range for Peep is
  0 to 20 $cmH_2O$ (mbar, hPa).
  **The factory default value is**
  **0 $cmH_2O$ (mbar, hPa).**

Pressure Support Mode (Optional)
Pressure Support ventilation is intended to reduce the work of breathing and is indicated for use only in patients who are breathing spontaneously. Patients who are not making spontaneous breathing efforts are not candidates for Pressure Support ventilation.

**Warning:** Pressure Support ventilation is triggered by the patient's spontaneous effort to breathe. Most anesthetic agents will cause patients to have reduced ventilatory responses to carbon dioxide and to hypoxemia. Therefore, patient triggered modes of ventilation may not produce adequate ventilation. Additionally, the use of neuromuscular blocking agents will interfere with patient triggering.

Apnoea Ventilation is a feature within Pressure Support Ventilation. To enable Apnoea Ventilation, adjust the Freq Min setting to a value other than “OFF”. If the detected patient spontaneous breathing rate falls below the set value, the ventilator automatically delivers a Pressure Support breath.

**Figure 29. Pressure Control Ventilation Screen**



**Warning:** Apnoea ventilation is intended to provide some degree of gas exchange if the patient's respiratory rate falls below the desired minimum setting. It is not intended as a primary mode of ventilation.

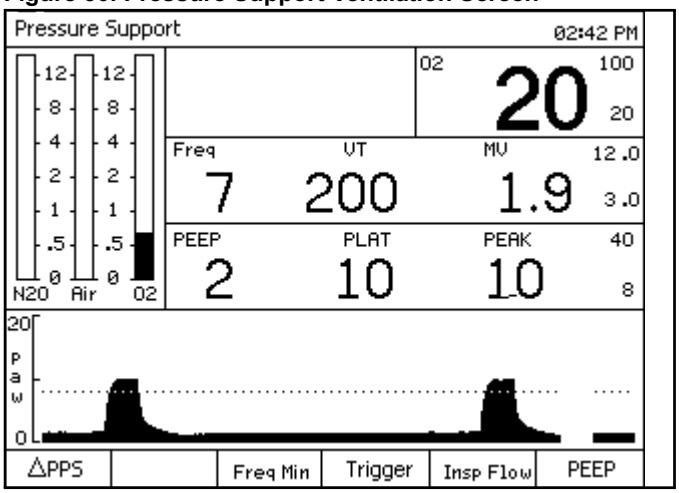
When delivering Apnoea Ventilation, the Fabius Tiro uses the Pressure Support settings for Δ PPS, Freq Min, Insp Flow, and PEEP.

If two consecutive Apnoea Ventilation breaths occur, the Caution message APNOEA VENTILATION !! appears in the Alarm window. The alarm is cleared when a spontaneous breath is detected.

The following soft key labels appear from left to right along the bottom of the Pressure Support screen. See Figure 30.

- Δ **PPS** (inspiratory pressure setting).
  The range for Δ **PPS** is
  3 to 20 cm$H_2O$.
  **The factory default value is 10.**
- **Freq Min** (minimum ventilation frequency setting for Apnoea Ventilation)
  The range for Freq Min is
  3 to 20 bpm and "OFF".
  **The factory default is 3.**
- **Trigger** (Trigger Level - patient inspiratory flow threshold for Pressure Support).
  The range for Trigger is
  2 to 15 L/min.
  **The factory default value is 2.**
- **Insp Flow** (maximum rate at which the piston travels upward to create the target pressure).
  The range for Insp Flow is
  10 L/min to 85 L/min.
  **The factory default value is 30 L/min.**
- **PEEP** (positive end expiratory pressure).
  The range for Peep is
  0 to 20 cm$H_2O$.
  **The factory default value is 0 cm$H_2O$.**

**Figure 30. Pressure Support Ventilation Screen**



SIMV / PS Mode (Optional)

Synchronized Intermittent Mandatory Ventilation (SIMV) mode is a mixture of mechanical ventilation and spontaneous breathing. In SIMV mode, the patient can breathe spontaneously. SIMV will attempt to synchronize the mandatory ventilation strokes with spontaneous efforts.

The mandatory ventilation strokes are the same as those for VOLUME ventilation. They are defined by the parameters Vt, Frequency, Tinsp, TIP:TI, and PEEP.

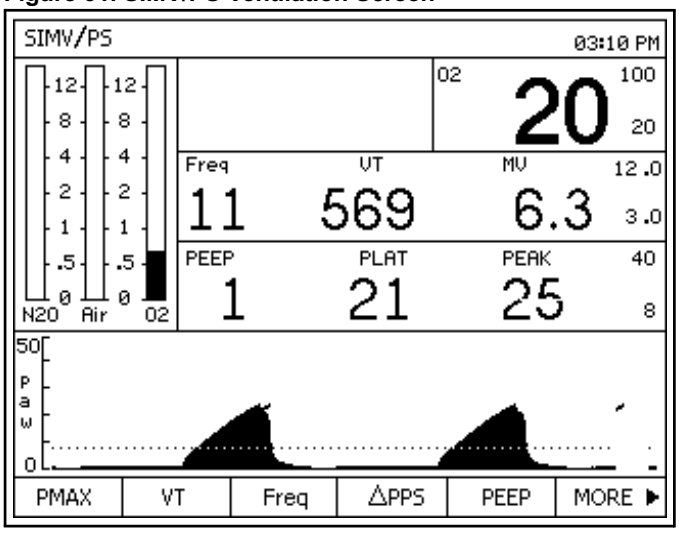
Pressure support can be added during SIMV mode to augment the patient's spontaneous breathing efforts. Adjusting the Δ PPS level to a value other than OFF will enable Pressure Support during SIMV mode. (Refer to the "Pressure Support Mode (Optional)" on page 32 for additional information on Pressure Support ventilation.)

The following soft key labels appear from left to right along the bottom of the SIMV / PS screen. See Figure 31.

- **PMAX** (maximum ventilation pressure).
  The range for PMAX is 15 to 70 $cmH_2O$.
  **The factory default value is 40 $cmH_2O$.**

  (PMAX setting must be at least 10 $cmH_2O$ above PEEP and must be greater than Δ PPS+PEEP)
- **VT** (tidal volume).
  The range for VT is 20 mL to 1100 mL.
  **The factory default value is 600 mL.**
- **Freq** (ventilation frequency).
  The range for Frequency is 4 bpm to 60 bpm.
  **The factory default value is 12 bpm.**
- Δ **PPS** (inspiratory pressure setting).
  The range for Δ **PPS** is 3 to 20 $cmH_2O$ or OFF.
  **The factory default value is 10.**
- **PEEP** (positive end expiratory pressure).
  The range for PEEP is 0 to 20 $cmH_2O$.
  **The factory default value is 0 $cmH_2O$.**

**Figure 31. SIMV/PS Ventilation Screen**



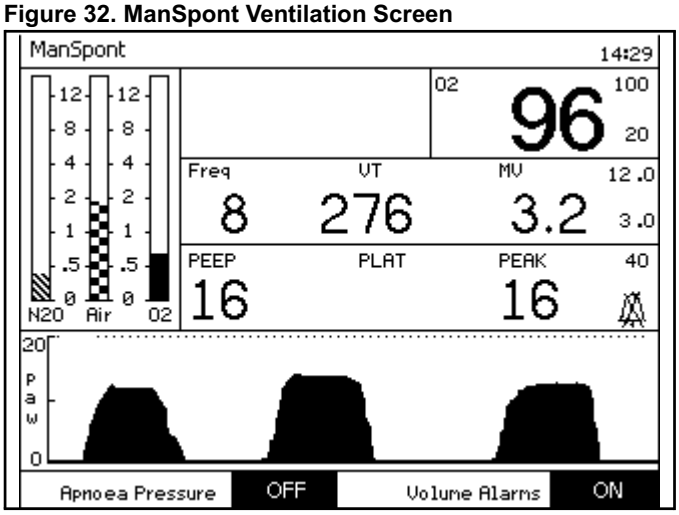
The following softkey labels can be accessed by pressing the “MORE” softkey as shown in Figure 31.

- **Trigger** (Trigger Level - patient inspiratory flow threshold for Pressure Support).
  The range for Trigger is
  2 to 15 L/min.
  **The factory default value is 2.**
- **Insp Flow** (maximum rate at which the piston travels upward to create the target pressure).
  The range for Insp Flow is
  10 L/min to 85 L/min.
  **The factory default value is 30 L/min.**
- **TINSP** (SIMV inspiratory time).
  The range for TINSP is 0.3 to 4.0 seconds
  **The factory default value is 1.7.**
- **TIP:TI** (relative inspiratory pause).
  The range for TIP:TI is 0% to 50%.
  **The factory default value is 10%.**

ManSpont Mode

The “Apnoea Pressure” and “Volume Alarms” labels appear to the left of their ON/OFF label on the bottom of the ManSpont screen. See Figure 32. Pressing the ON/OFF soft key turns the applicable alarm(s) “ON” or “OFF”.

**Figure 32. ManSpont Ventilation Screen**



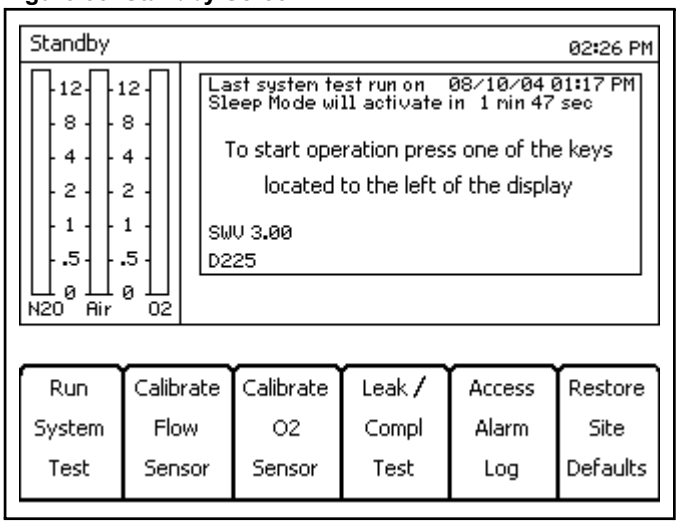
Standby Mode

The following soft key labels appear from left to right along the bottom of the Standby screen.
See Figure 33.

- Run System Test
- Calibrate Flow Sensor
- Calibrate O2 Sensor
- Leak / Compl Test
- Access Alarm Log
- Restore Site Defaults

See “Standby Screen” on page 119 for details.

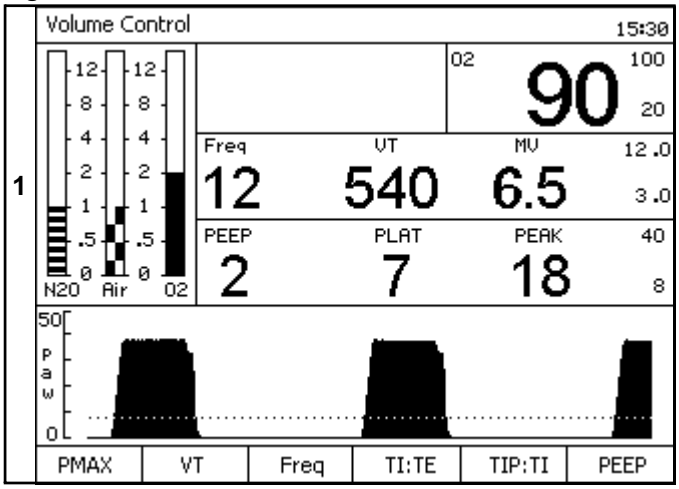
**Figure 33. Standby Screen**




### Flow Meter Monitor Window

The Flow Meter Monitor window is a graphical display of the flow rates of $O_2$, Air, and $N_2O$ (L/min) (**1** in Figure 34).

**Figure 34. Flow Meter Monitor Window**



## Changing Ventilation Modes

### Volume Control (IPPV) and Pressure Control (PCV)

The following example describes changing

- from the present ventilation mode “Volume Control” (**1** in Figure 35)
- to the desired ventilation mode “Pressure” (**2** in Figure 35) with the desired ventilation settings (**3** in Figure 35).

1. Press the Pressure Control (PCV) key.

   The LED associated with this key starts blinking (**4** in Figure 35). It remains blinking until the selected mode of operation is confirmed.

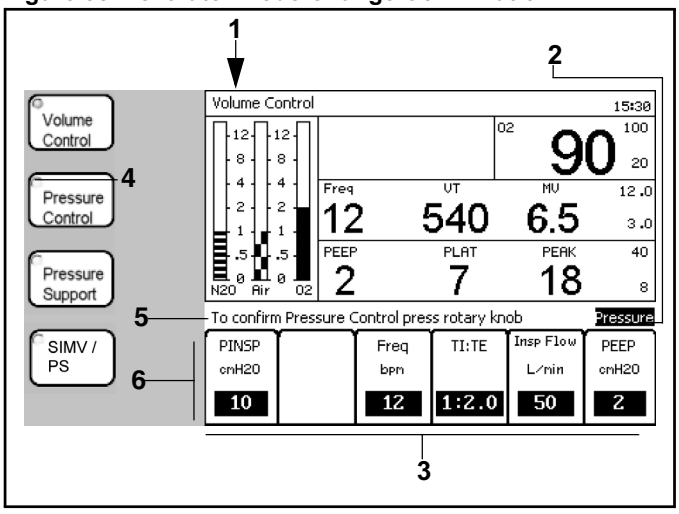
   A message appears (**5** in Figure 35) that provides instructions to confirm the mode change.

   The Waveform window is replaced by the Ventilator Settings window (**6** in Figure 35) (Volume and Pressure modes only).

2. If the ventilation settings are correct, confirm the mode change.
3. If the ventilation settings are not correct, for each parameter that needs to change, press the corresponding soft key, select the correct value, and confirm the change.
4. When the parameter changes are completed, confirm the ventilation mode change.

   After the mode change is confirmed, the Pressure Control key LED switches from blinking to constantly on, the ventilator switches to the selected operating mode, and the waveform is restored.

**Figure 35. Ventilator Mode Change Confirmation**



### Ventilator Setting Selection

Selected ventilator settings for the new mode of operation are automatically derived from the settings and performance of the last confirmed automatic ventilation mode. Settings affected in the new mode will be highlighted (**1** in Figure 36).

The settings for **Freq., TI : TE, and PEEP** are taken directly from the settings used in the former mode as applicable.

When changing from Volume Control to Pressure Control, **PINSP** is set to the Plateau pressure developed in Volume Control.

When changing from Volume Control to Pressure Control, the suggested value for **Insp. Flow** is either the last used value or the site default value.

When changing from Pressure Control to Volume Control, **VT** is set by dividing the last minute volume by the respiratory rate.

When changing from Pressure Control to Volume Control, the suggested value for **TIP:TI** is either the last used value or the site default value.

When changing from Pressure Control to Volume Control, **PMAX** is set 10 $cmH_2O$ higher than the plateau pressure developed during Pressure Control.

When changing from Volume Control or Pressure Support to Pressure Control, the suggested value for **Insp. Flow** is either the last used value or the site default value.

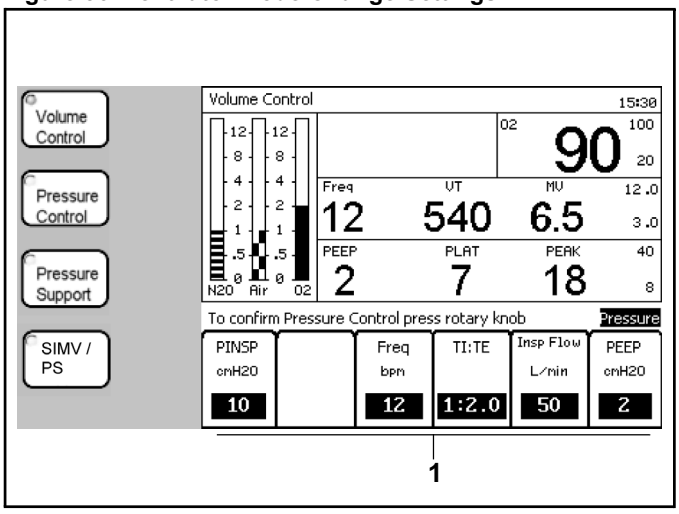
When changing from Volume Control or Pressure Control to Pressure Support, the suggested value for **Insp. Flow** is either the last used value or the site default value.

When changing from Volume Control or Pressure Control to Pressure Support, the suggested value for ∆ **PPS** is either the last used value or the site default value.

When changing from Volume Control or Pressure Control to Pressure Support, the suggested value for **Trigger** is either the last used value or the site default value.

When switching between Volume Control mode and SIMV/PS mode, the **PMAX** and **PEEP** settings shall automatically be transferred from the previous mode to the new mode.

**Figure 36. Ventilator Mode Change Settings**



When switching from Pressure Support mode to SIMV/PS mode, the Δ **PPS**, **Insp Flow**, **Trigger**, and **PEEP** settings shall automatically be transferred from the previous mode to the new mode.

When switching from SIMV/PS mode with Pressure Support enabled to Pressure Support mode, the Δ **PPS** and **Insp Flow** settings shall automatically be transferred from SIMV/PS to Pressure Support.

When switching from SIMV/PS mode to Pressure Support mode, the **Trigger** and **PEEP** settings shall automatically be transferred from SIMV/PS to Pressure Support.

### ManSpont

The following examples describe changing

- from the present ventilation mode “Volume Control” (**1** in Figure 37)
- to the desired ventilation mode “ManSpont” (**2** in Figure 37).

Spontaneous Breathing

1. Press the ManSpont key.

   The LED associated with this key starts blinking (**3** in Figure 37). It remains blinking until the selected mode of operation is confirmed.

   The Waveform window is replaced by the ManSpont window (**4** in Figure 37).

   A message appears (**5** in Figure 37) that provides instructions to confirm the mode change.

2. Confirm the mode change. The ManSpont screen is activated (Figure 38).

   After the mode change is confirmed, the ManSpont key LED switches from blinking to constantly on and the waveform is restored.

3. Rotate the APL valve knob fully counterclockwise to release pressure for spontaneous ventilation.

4. Set the appropriate fresh gas flow.

   **Note:** The ManSpont screen enables you to turn the Apnoea Pressure alarm and Volume alarms ON or OFF.

See “APL Valve” on page 47 for more information.

**Figure 37. Ventilator Mode Change to ManSpont**

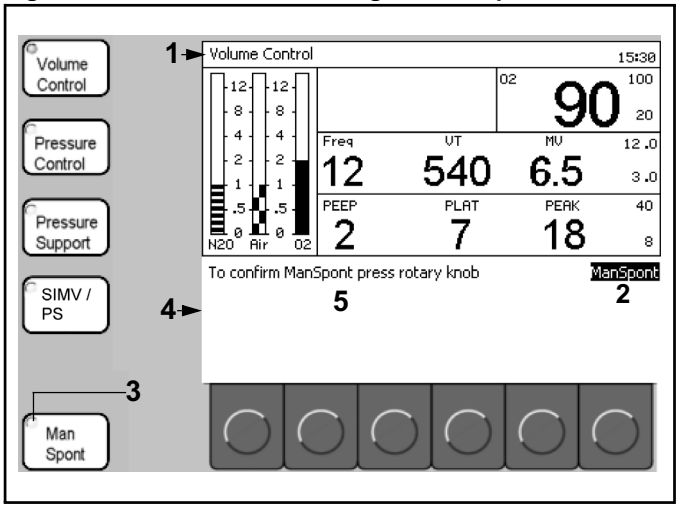
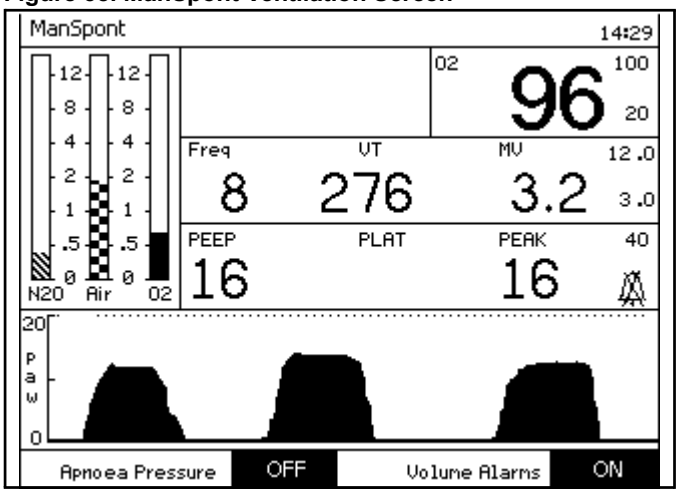



**Figure 38. ManSpont Ventilation Screen**



Manual Ventilation

**Note:** In ManSpont mode, the apnoea volume timer countdown for caution alarms changes from 15 seconds to 30 seconds, and for warning alarms from 30 seconds to 60 seconds.

1. Press the ManSpont key.

   The LED associated with this key starts blinking (**1** in Figure 39). It remains blinking until the selected mode of operation is confirmed.

   The Waveform window is replaced by the ManSpont window (**2** in Figure 39).

   A message appears (**3** in Figure 39) that provides instructions to confirm the mode change.

2. Confirm the mode change. The ManSpont screen is activated (Figure 40).

   After the mode change is confirmed, the ManSpont key LED switches from blinking to constantly on and the waveform is restored after a short delay.

   **Note:** The ManSpont screen enables you to turn the Apnoea Pressure alarm and Volume alarms ON or OFF.

3. Adjust the APL valve knob to set the appropriate value for the maximum ventilation pressure (see “APL Valve” on page 47).
4. Press the $O_2$ flush button, as required, to inflate the bag.
5. Set the fresh gas flow.
6. Start manual ventilation.

**Figure 39. Ventilator Mode Change to ManSpont**

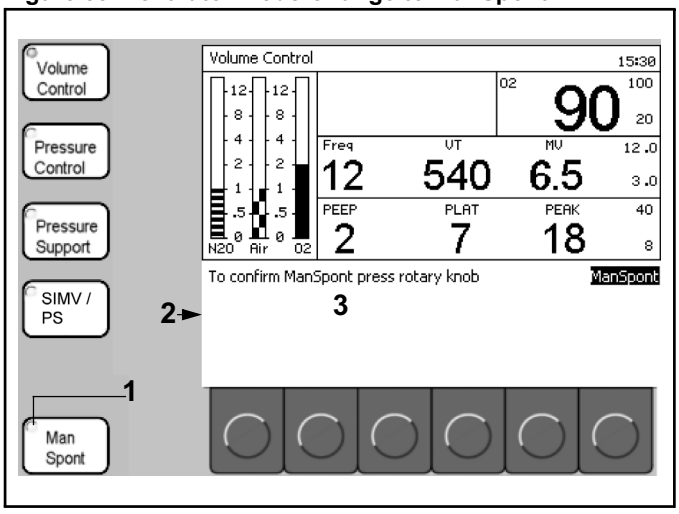
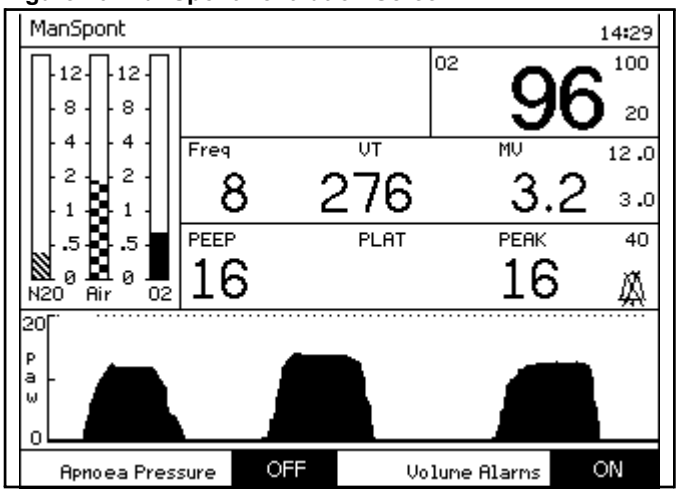



**Figure 40. ManSpont Ventilation Screen**



## Selecting/Setting Ventilation Parameters

1. In **Volume Control mode (IPPV)**, press the Volume Control key. The Volume Control Ventilation Settings window (**1** in Figure 41) replaces the Waveform window.

   In **Pressure Control mode (PCV)**, press the Pressure Control key. The Pressure Control Ventilation Settings Window (**1** in Figure 42) replaces the Waveform window.

   In **Pressure Support mode**, press the Pressure Support key. The Pressure Support Ventilation Settings Window (**1** in Figure 43) replaces the Waveform window.

**Figure 41. Volume Ventilator Settings Window**

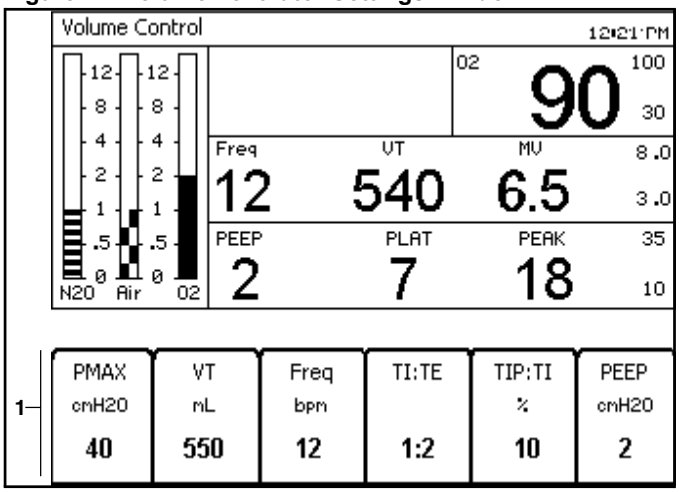



**Figure 42. Pressure Control Ventilator Settings Window**

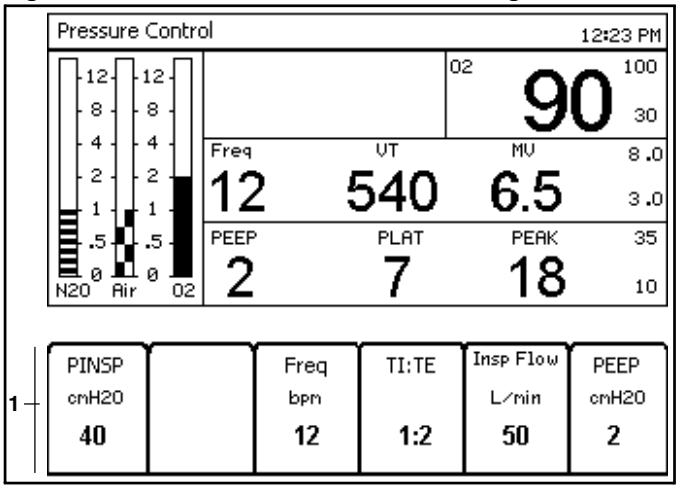
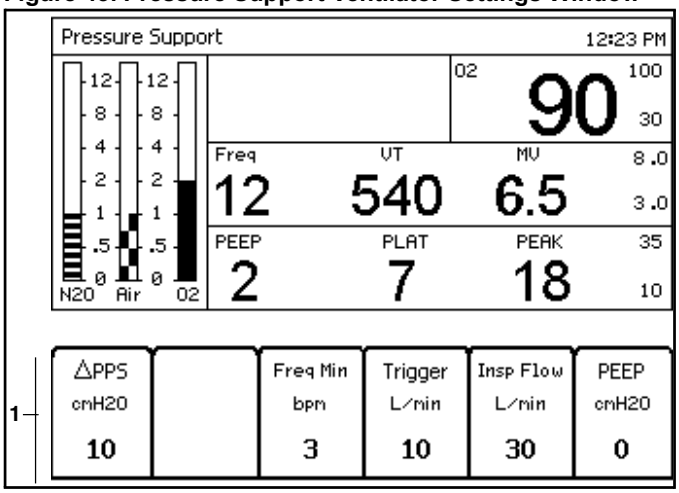



**Figure 43. Pressure Support Ventilator Settings Window**



In **SIMV/PS mode**, press the SIMV/PS key. The SIMV/PS Ventilation Settings Window (**1** in Figure 44 or Figure 45) replaces the Waveform window.

**Figure 44. SIMV/PS Ventilator Settings Window (Screen 1)**

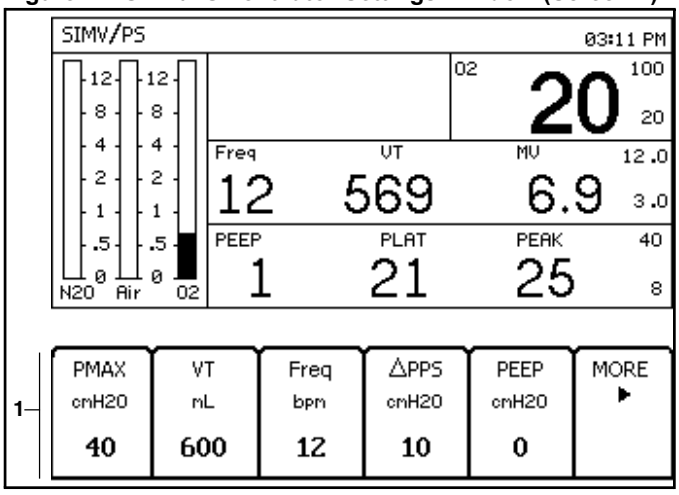
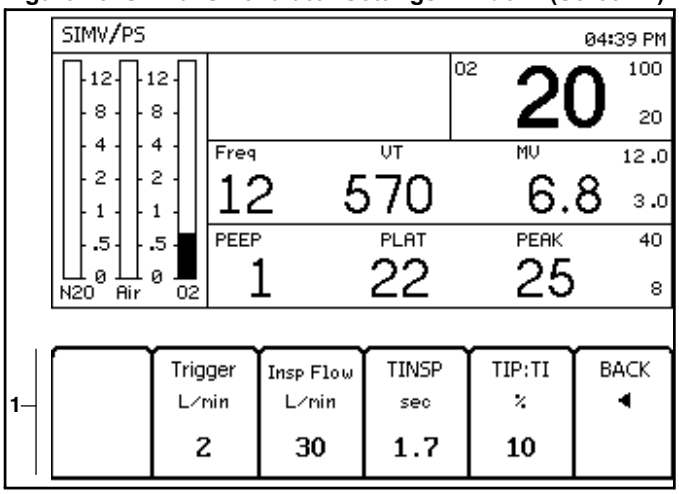



**Figure 45. SIMV/PS Ventilator Settings Window (Screen 2)**



The following example continues in **Volume Control mode (IPPV)**.

2. Press the VT (tidal volume) soft key.

   The Ventilator Settings window appears with the VT parameter label highlighted (**1** in Figure 46).

3. Select a new VT parameter setting.

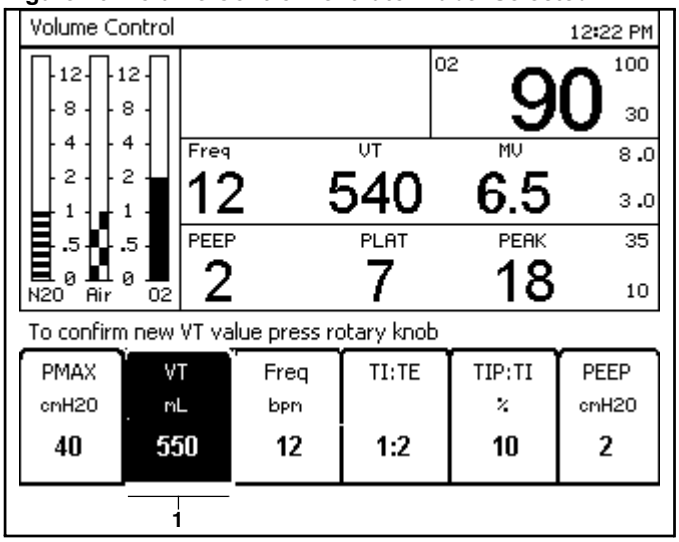
4. Confirm the new VT parameter setting.

**Note:** Once the Ventilator Settings window is activated, it will return to the Waveform window if 15 seconds pass and neither the rotary knob nor a soft key is pressed.

If the Home key is pressed, the Ventilator Settings window will return to the Waveform window.

In either case, the ventilation parameter will remain as it was before it was activated in the Ventilator Settings window.

**Figure 46. Volume Control Ventilator Label Selected**



## Fresh Gas Control

The following numbers in boldface refer to Figure 47. Flow is increased when the **flow control knobs** ($N_2O$ (**1**), AIR (**2**), $O_2$ (**3**)) are turned counterclockwise.

The **total flow meter** (**4**) displays the flow measurement of all of the applied gases combined.

**Note:** The total flow meter is calibrated for a 50/50 mixture of $N_2O$ and $O_2$. The accuracy of the flow meter may degrade with other gas mixtures. (See the Technical Data section for specifications.)

The total flow meter serves two purposes. The total flow meter provides a reference of the **total** fresh gas applied to the breathing circuit. (Flow rate measurements for each individual gas; $N_2O$, Air, and $O_2$; are provided by their respective electronic flow indicator.)

Should a fault develop in the electronic flow sensing, digital display, or power circuitry, the total flow meter is still functional. The measurement will indicate the total flow rate prior to the fault condition.

To adjust the fresh gas ratios while under the fault condition, shut off all flows ($O_2$ may be left on), and then restore each gas flow individually. For example, start with 2 L/min $O_2$. The total flow meter will read 2 L/min.
If 1 L/min of $N_2O$ is needed, open the $N_2O$ flow control knob until the total flow meter reads 3 L/min to 2 L/min $O_2$ plus 1 L/min $N_2O$.

The **electronic fresh gas flow meters** ($N_2O$ (**5**), AIR (**6**), $O_2$ (**7**)) display the flow measurement of each gas.

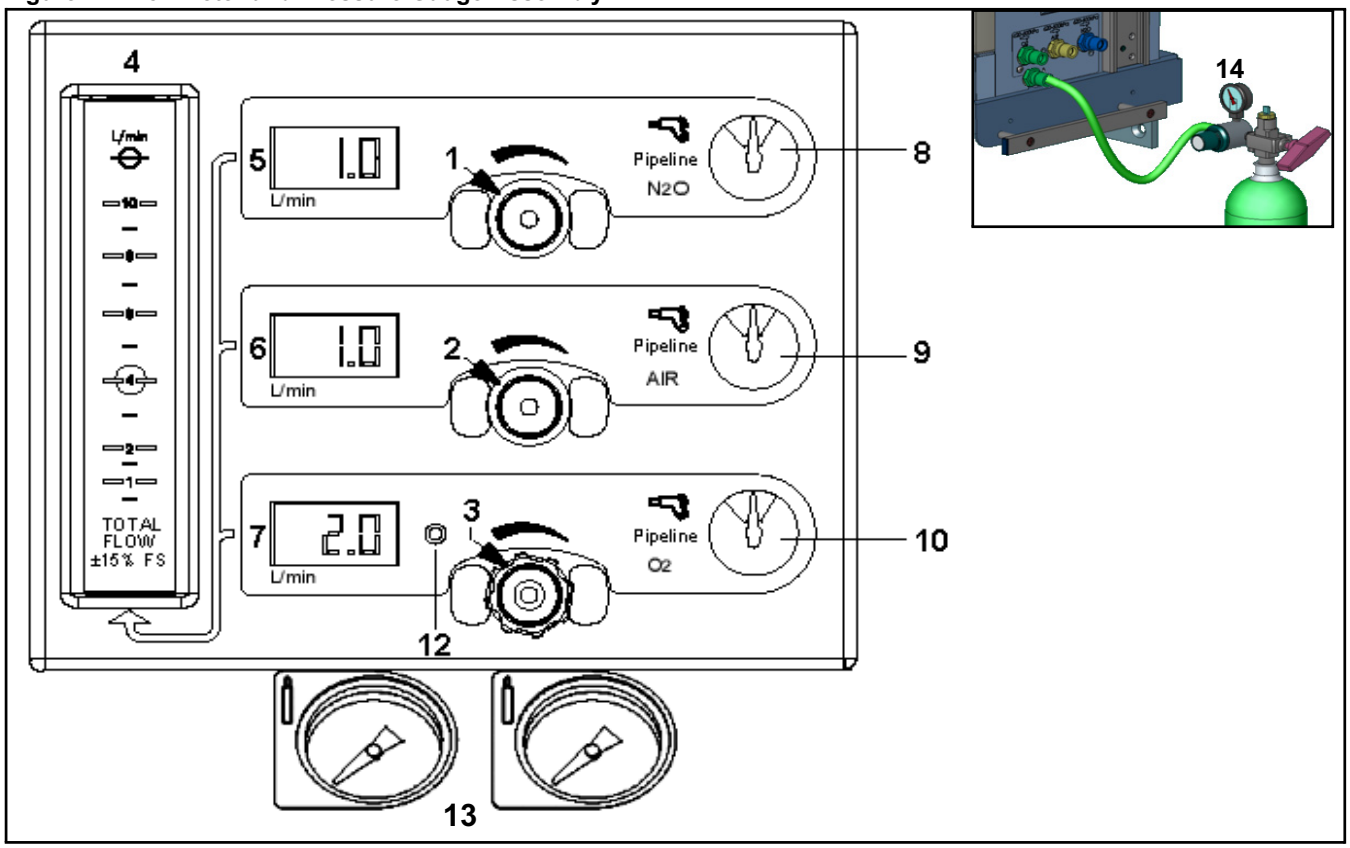
**Note:** The electronic fresh gas flow meters are altitude corrected.

The **central supply pressure indicators** ($N_2O$ (**8**), AIR (**9**), $O_2$ (**10**)) display the pressure measurement of each gas entering the Fabius Tiro from the facility's pipeline.

The **$O_2$ Low Supply Pressure Alarm LED** (**12**) flashes when the $O_2$ supply is below the factory set minimum pressure, nominally 20 psi (1.4 bar).

The **cylinder gauges** (**13**: trolley mount only; **14**: on pressure reducer, wall mount only) display the pressure measurement of each gas entering the Fabius Tiro from pin index-type cylinders.

**Figure 47. Flowmeter and Pressure Gauge Assembly**



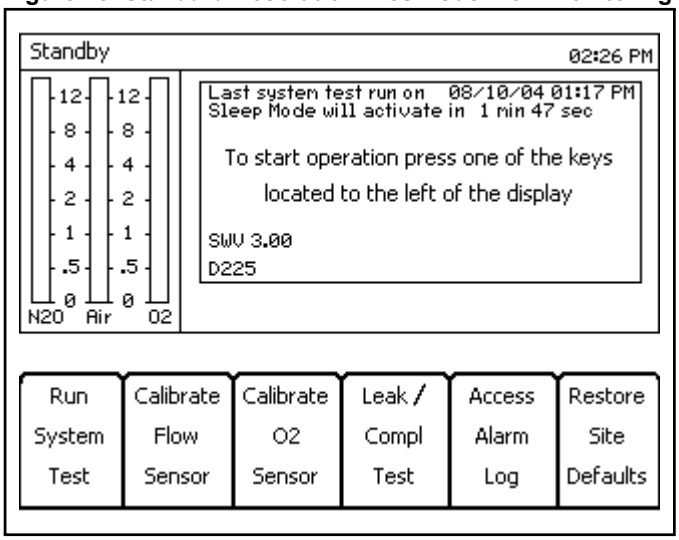
# Fresh Gas Flow Monitoring Resolutions

The Fabius Tiro can be configured by DrägerService to display fresh gas flow rates either in a standard resolution mode or in a high resolution mode.

## Standard Resolution

If standard resolution is configured (Figure 48), the numeric displays (LEDs) for the fresh gas flow rates support 100 mL/min. increments (format xx.x L/min.) and the flow meters on the monitor screen indicate a range of 0 to 12 L/min.

**Figure 48. Standard Resolution Fresh Gas Flow Monitoring**




## High Resolution

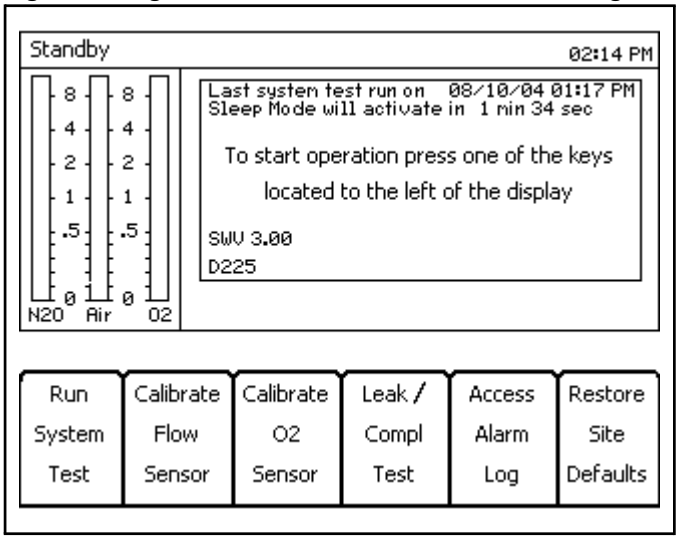
If high resolution is configured (Figure 49), the numeric displays (LEDs) for the fresh gas flow rates support 10 mL/min. increments (format x.xx l/min.) and the flow meters on the monitor screen indicate a range of 0 to 10 L/min. with an emphasis on resolution at the lower end of the scale.

High-resolution data is displayed when all individual gas flows are below 9.99 L/min.

Switching to standard resolution occurs when the highest flow rate is greater than 9.99 L/min.

Switching to high resolution occurs when the highest flow rate drops below 9.00 L/min.

**Figure 49. High Resolution Fresh Gas Flow Monitoring**



## APL Valve

**Warning:** Route all lines/cables away from the APL valve to prevent interference with the APL valve adjustment knob. Lines/cables caught underneath the APL valve adjustment knob could interfere with proper functioning of this valve.

The following numbers in boldface refer to Figure 50.

The APL valve (**1**) has two functions. It limits the maximum pressure during manual ventilation. It also exhausts excess gas into the scavenger system during manual and spontaneous ventilation.

The APL valve is connected to the patient airway through the ventilator. It functions only when the ventilator is in ManSpont mode or ventilator override condition.

The APL valve has a labeled knob (**2**) for selecting between spontaneous and manual modes of ventilation and for indicating approximate pressure settings.

When the APL valve knob is rotated fully counterclockwise, pressure is released for spontaneous ventilation. Spontaneous ventilation automatically eliminates resistance to patient exhalation.

In manual mode, the APL valve knob can be rotated to change the pressure threshold at which gas will flow through the valve and into the scavenging system. Clockwise rotation of the APL valve knob increases the pressure threshold, and counterclockwise rotation of the APL valve knob decreases the pressure threshold. Lifting the top of the APL valve knob will temporarily relieve pressure.

**Note:** The APL valve is automatically excluded from the breathing circuit whenever an automatic ventilator mode is selected.

**Figure 50. APL Valve**

# Preparation

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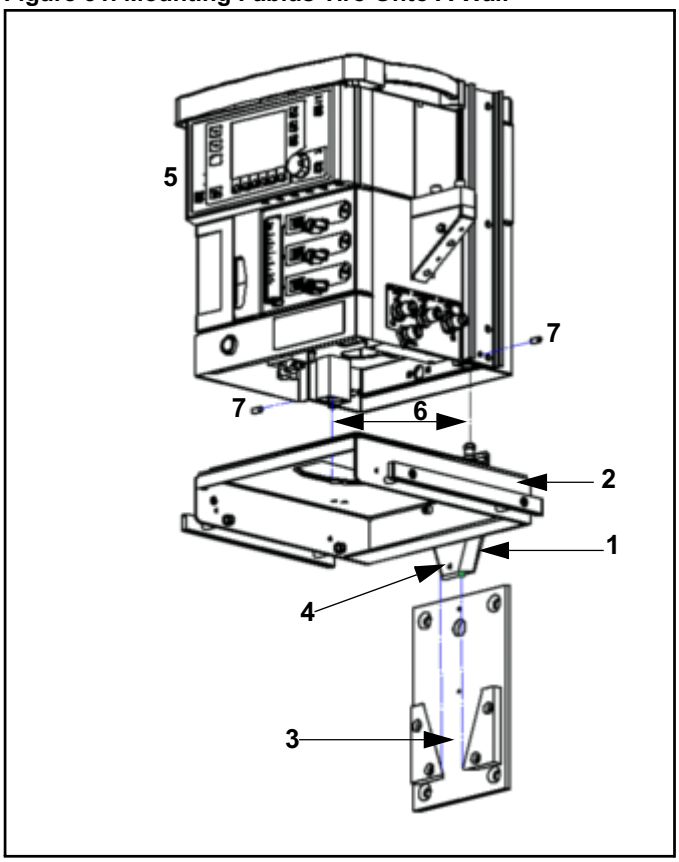
**Note:** Complete the Periodic Manufacturer's Service procedure (SP00267) after you set up the Fabius Tiro anesthesia machine.

## Mounting the Fabius Tiro Onto A Wall

The following bolded numbers refer to Figure 51.

1. Insert the male dovetail (**1**), located on the rear of the wall mount bracket (**2**), into the wall-mounted female dovetail assembly (**3**).
2. Tighten the retaining screw (**4**).
3. Place the Fabius Tiro Core Module (**5**) on top of the two swivel plate pins (**6**) so that the pins enter into the applicable Fabius Tiro Core Module pin holes.
4. Tighten the two set screws (**7**) with a hex key.

**Figure 51. Mounting Fabius Tiro Onto A Wall**

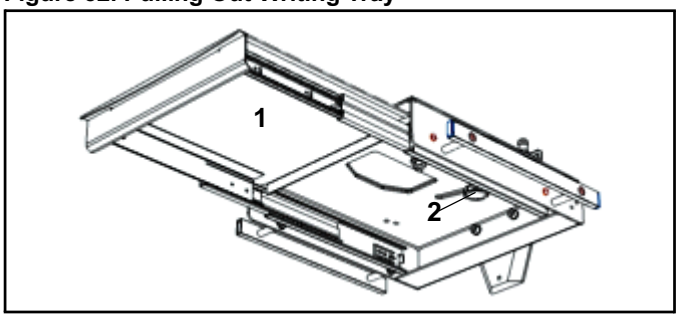



### Accessing The Connector Panel

The following bolded numbers refer to Figure 52.

5. Pull out the writing tray (**1**) to expose the swivel plate retention knob (**2**).

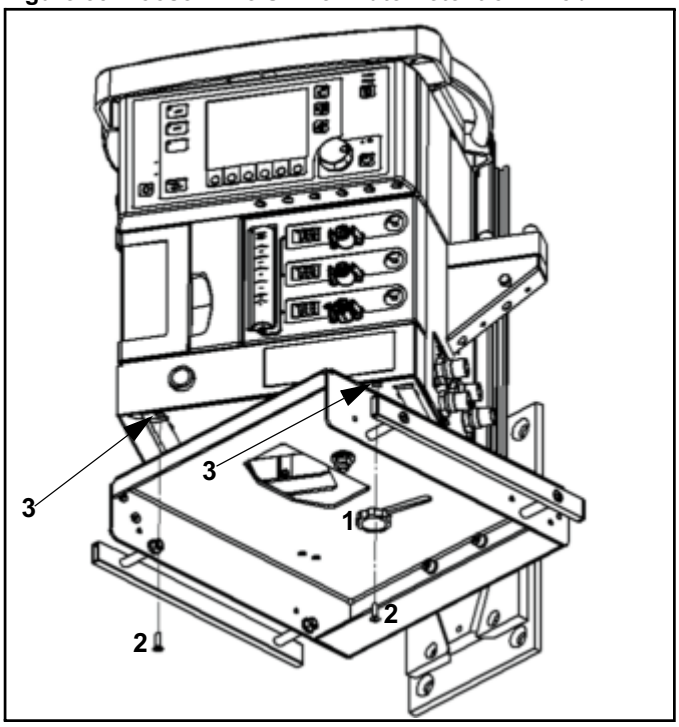
**Figure 52. Pulling Out Writing Tray**



The following bolded numbers refer to Figure 53.

6. Turn the swivel plate retention knob (**1**) clockwise to loosen the Fabius Tiro module.
7. Rotate the Fabius Tiro module counterclockwise.
8. Insert and tighten the two screws (**2**) into the bottom of the swivel plate (**3**).

**Figure 53. Loosen The Swivel Plate Retention Knob**

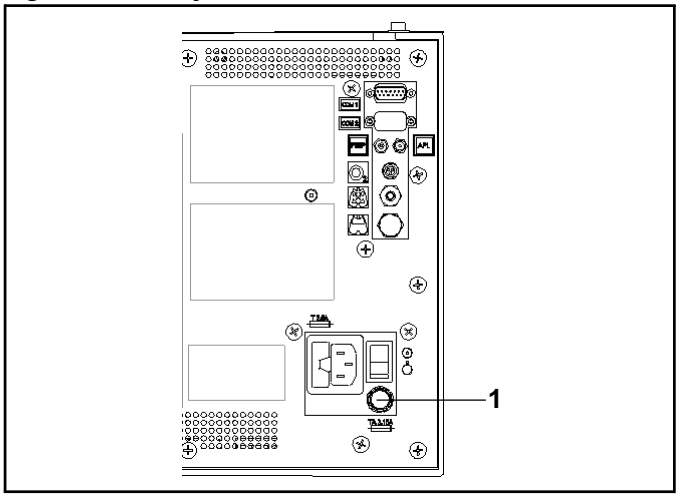



## Activating the Battery

The Fabius Tiro anesthesia machine is shipped with the battery fuse disconnected in order to prevent discharge during shipment and storage prior to installation.

1. Remove the battery fuse from the top drawer of the Fabius Tiro.
2. Remove the battery fuse from its packaging.
3. Insert the battery fuse into the battery fuse holder (**1** in Figure 54) (turn the fuse 1/4-turn clockwise until it is snug).

**Figure 54. Battery Fuse**



## Gas Supply

**Note:** Medical gases must be dry and free from dust and oil.

The medical gas pipeline supply connections are shown in Figure 55.

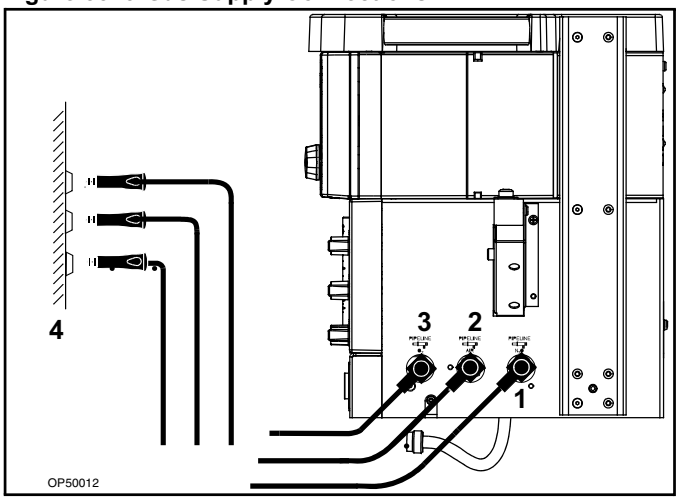
## Medical Gas Pipeline Supply of $O_2$, $N_2O$, and AIR

**Warning:** Carefully check hoses each time you connect a machine to a wall or ceiling outlet to ensure that both ends of the hose are indexed for the same gas. Pipeline delivery hoses used between wall outlets and anesthesia machines have caused accidents when, during assembly, an oxygen fitting was placed on one end of the hose and a nitrous oxide fitting on the other end.

The following numbers in boldface refer to Figure 55.

1. Connect the $N_2O$ hose (**1**) to the connector on the Fabius Tiro and to the wall terminal unit (**4**) of the medical gas pipeline system.
2. Connect the AIR hose (**2**) to the connector on the Fabius Tiro and to the wall terminal unit (**4**) of the medical gas pipeline system.
3. Connect the $O_2$ hose (**3**) to the connector on the Fabius Tiro and to the wall terminal unit (**4**) of the medical gas pipeline system.

**Figure 55. 3-Gas Supply Connections**



## Cylinders with Threaded Connectors

**Caution:** Do not oil or grease the $O_2$ cylinder valves and $O_2$ pressure regulator. There is a risk of explosion.

If cylinder valves are leaky or difficult to open or close, they must be repaired in accordance with the manufacturer's specifications.

Even if the gas supply is connected to a medical gas pipeline, the cylinders should remain on the device in reserve.

**Caution:** The cylinder valves must only be opened or closed manually. Never use tools.

1. Place the full cylinders in the cylinder holders and secure them in position. Do not place the $O_2$ cylinder in the right-side position when facing the rear of the machine (**1** in Figure 57).
2. Screw the pressure regulators onto the cylinder valves.
3. Screw the compressed gas hoses to the pressure regulators and to the connections of the gas inlet block.
4. Open the cylinder valves.

**Warning:** $O_2$ cylinders are not to be installed in the right-side position when facing the rear of the machine.

**Figure 56. Gas Supply Connections**

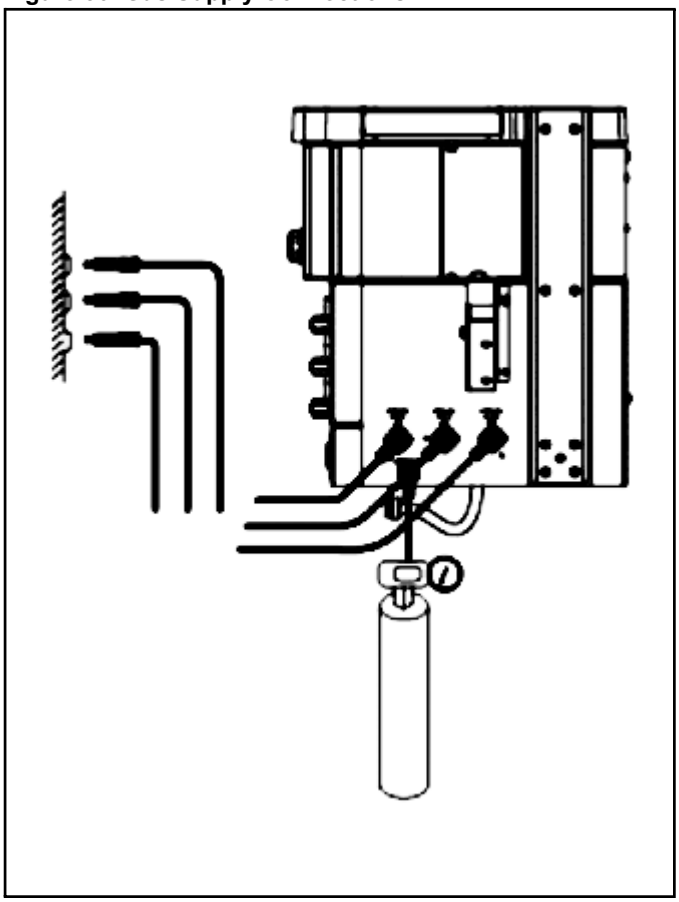
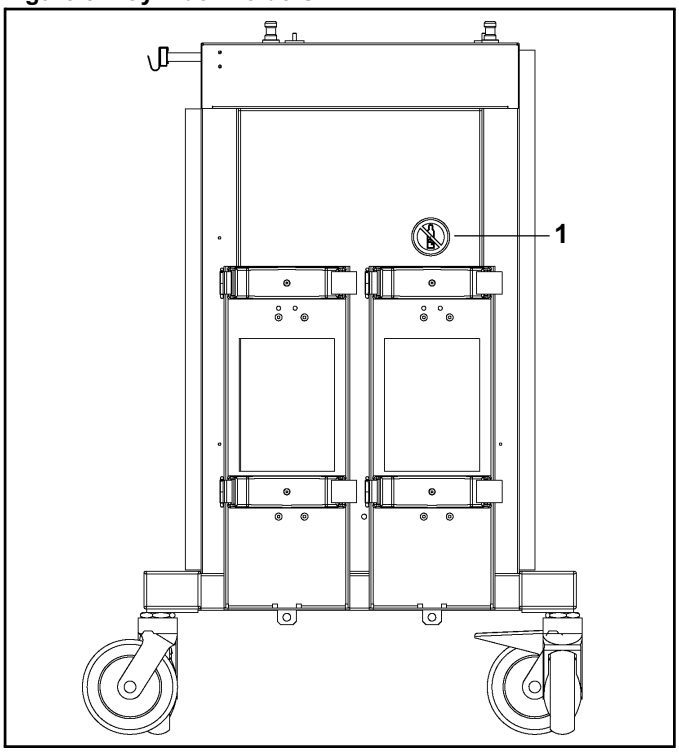


**Figure 57. Cylinder Holders**



## Cylinders with Pin-index Mounting

**Warning:** When attaching a cylinder, ensure that only one washer is installed between the cylinder and the yoke gas inlet. The use of multiple washers will inhibit the pin-index safety system. Be sure to verify the presence of the index pins each time a cylinder is installed. Never attempt to override the pin-index safety system.

**Caution:** Do not oil or grease the $O_2$ cylinder valves and $O_2$ pressure regulator. There is a risk of explosion.

If cylinder valves are leaky or difficult to open or close, they must be repaired in accordance with the manufacturer's specifications.

Even if the gas supply is connected to a medical gas pipeline, the cylinders should remain on the device in reserve.

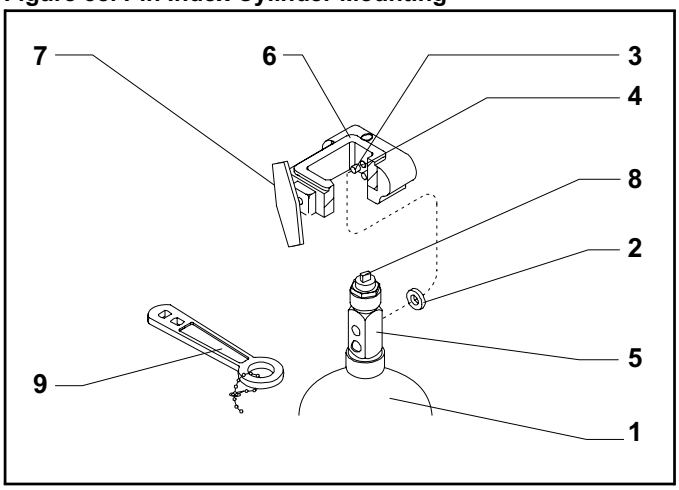
The following numbers in boldface refer to Figure 58.

To connect a gas cylinder (**1**) to its yoke:

1. Remove the old washer (**2**) and install a new washer on the seat of the yoke gas inlet connection.
2. Verify that the two index pins (**3**) below the gas inlet (**4**) are present.
3. Insert the head (**5**) of the gas cylinder into the yoke from below. Ensure that the gas outlet and indexing holes on the cylinder head align with the gas inlet and index pins of the yoke assembly (**6**).
4. Engage the indexing holes with the index pins.
5. Turn the yoke handle (**7**) clockwise against the cylinder head, so that the point of the yoke handle bolt is aligned with the indent on the back of the cylinder head.
6. Verify that the washer is in place, the index pins are engaged, and the cylinder hangs vertically.
7. Tighten the yoke firmly.

   When required, the cylinder valve (**8**) is opened using the cylinder wrench (**9**) that is provided.

**Figure 58. Pin Index Cylinder Mounting**



Cylinders attached to the hanger yokes must contain gas at the recommended pressures outlined in Table 1. (Indicated pressures are of E-size cylinders at 70 °F, or 21 °C.) Cylinders measuring less than the minimum recommended pressure (PSI - MIN) should be replaced with new, full cylinders.

**Table 1. Recommended Cylinder Gas Pressures**

| GAS | PSI/bar - FULL (typical full load) | PSI/bar - MIN |
|---|---|---|
| Nitrous Oxide | 745/51 | 600/42 |
| Oxygen | 1900/131 | 1000/69 |

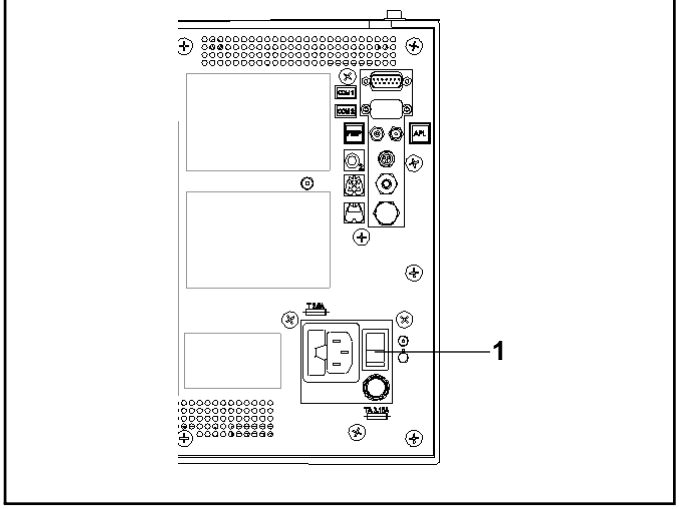
## Electrical Supply

Fabius Tiro can be operated at mains voltages from 100 V to 240 V.

Push power plug into supply mains socket.

Switch on the machine. The system power switch (**1** in Figure 59) is on the rear of the machine.

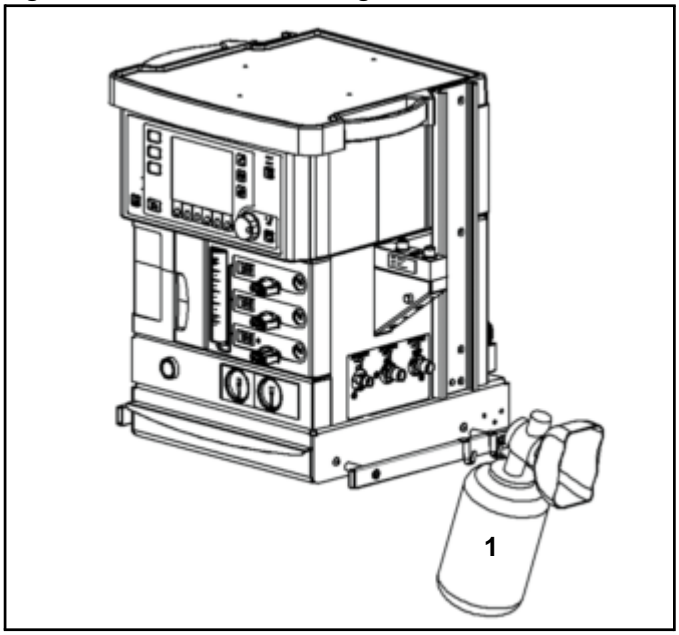
**Figure 59. Power Switch**




## Attaching Manual (Ambu) Ventilation Bag

Hang the fully prepared and tested bag (**1**) on a wall rail (wall mounted Fabius Tiro) or on a trolley rail (trolley mounted Fabius Tiro).

**Figure 60. Ambu Ventilation Bag**



## Preparing the Ventilator

Use only disinfected/sterilized components.

The following numbers in boldface refer to Figure 61.

1. Swing out the ventilator door (**1**).
2. Unlatch the three clasps (**2**) to remove the cover (**3**).
3. Insert the diaphragm (**4**).
4. Fit the cover (**3**) and lock the three clasps.
5. Connect the ventilator chamber pressure sensor line (**5**) to the ventilator chamber pressure sensor line port (**6**).
6. Swing the ventilator unit (**1**) back into position.

## Ventilator Safety Features

- High pressure safety relief valve (**A**)
- Negative pressure safety relief valve (**B**)
- Ventilator chamber pressure sensor

## Attaching the $CO_2$ Absorber onto the Compact Breathing System

1. Remove the absorber canister (see “Replacing CO2 Absorbent” on page 80 for more information).
2. Fill the absorber with fresh $CO_2$ absorbent to the fill line.
   Dräger recommends the use of Drägersorb® 800 Plus or Drägersorb® FREE.

**Note:** Ensure that no $CO_2$ absorbent dust/particles have been deposited between the gaskets and the sealing surfaces. Such dust and particles can cause leaks in the system.

3. Tighten the absorber by turning it to the right into the compact breathing system.

**Figure 61. Ventilator Assembly**

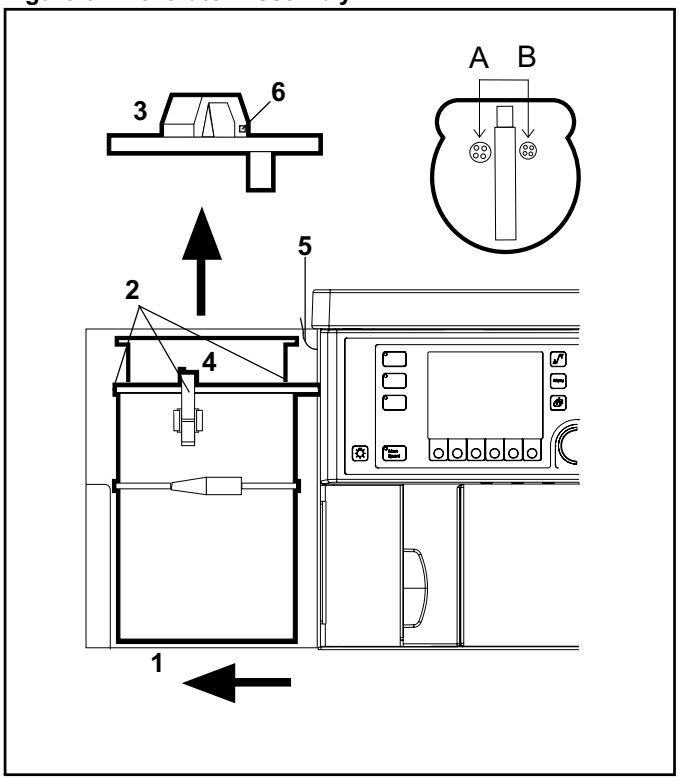
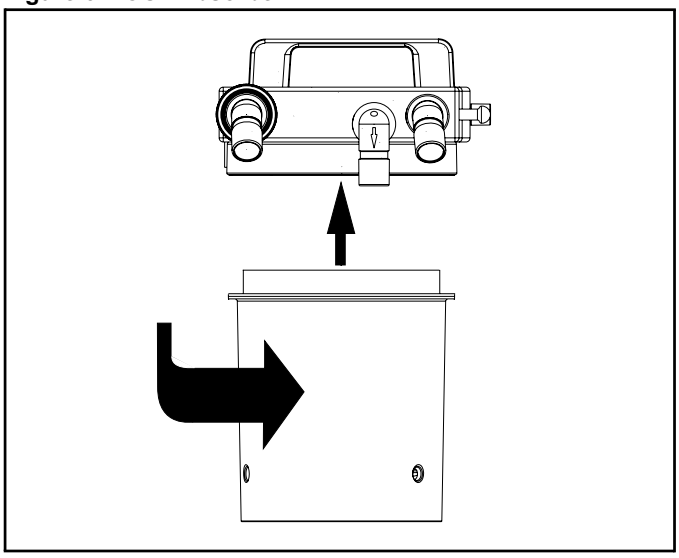



**Figure 62. $CO_2$ Absorber**



## Attaching the Inspiratory Valve

The following numbers in boldface refer to Figure 63.

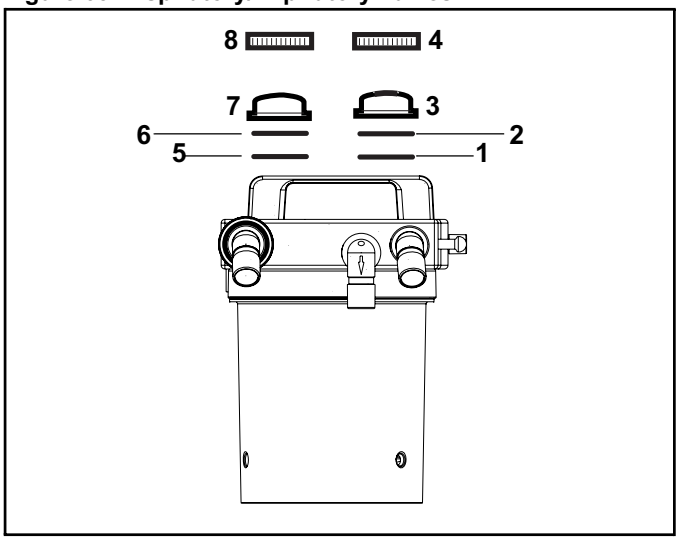
1. Place the valve disc (**1**) in the valve seat.
2. Place the gasket (**2**) on top of the valve disc.
3. Fit the inspection cap (with port) (**3**).
4. Tighten the retaining nut (**4**) securely.

## Attaching the Expiratory Valve

The following numbers in boldface refer to Figure 63.

1. Place the valve disc (**5**) in the valve seat.
2. Place the gasket (**6**) on top of the valve disc.
3. Fit the inspection cap (**7**).
4. Tighten the retaining nut (**8**) securely.

**Figure 63. Inspiratory/Expiratory Valves**

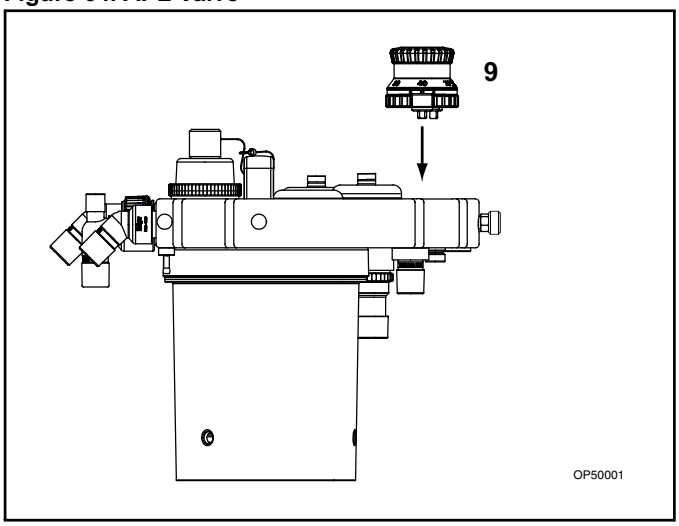



## Attaching the Adjustable Pressure Limiting (APL) Valve

**Warning:** Route all lines/cables away from the APL valve to prevent interference with the APL valve adjustment knob. Lines/cables caught underneath the APL valve adjustment knob could interfere with proper functioning of this valve.

Tighten the APL valve (**9** in Figure 64) securely into place with the retaining nut.

**Figure 64. APL Valve**



## Inserting the Flow Sensor

The following numbers in boldface refer to Figure 65.

1. Unscrew and remove the expiration port (**1**).
2. Insert the flow sensor (**2**).
3. Reinstall the expiration port (**1**).

## Attaching the Waste Gas Outlet Port

Screw the waste gas port into the compact breathing system from underneath (**3** in Figure 65).

## Connecting the Compact Breathing System

The following numbers in boldface refer to Figure 66 and Figure 67.

**Caution:** The sealing rings on the threaded and conical connectors (**5** and **6**) must be undamaged and clean.

**Caution:** Only hand-tighten the threaded connectors. Do not use tools.

1. Pull and hold plunger (**1**) out to its full extension on the compact breathing system.
2. Fit the compact breathing system onto the compact breathing system mount (**2**).
3. Release the plunger (**1**) and rotate the compact breathing system until the plunger locks into position.
4. Screw the fresh gas hose from the Fabius Tiro (**3**) to the compact breathing system (**4**).
5. Screw the ventilation hose to the ventilator (**5**) and attach it to the conical connector ventilator port on the compact breathing system (**6**).

**Figure 65. Flow Sensor Assembly**

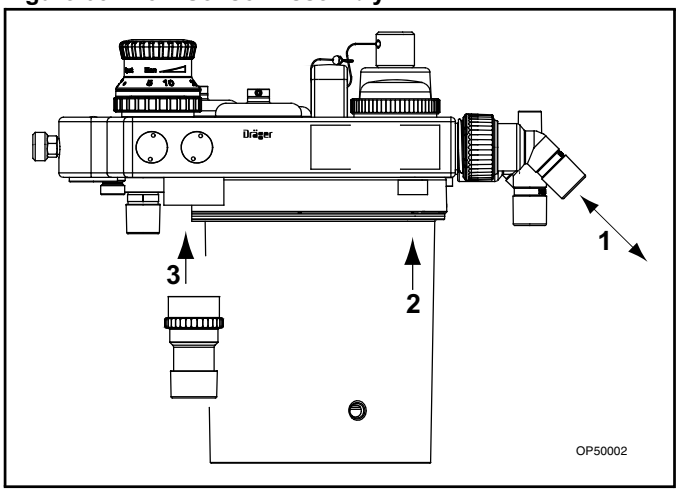



**Figure 66. Compact Breathing System Installation**

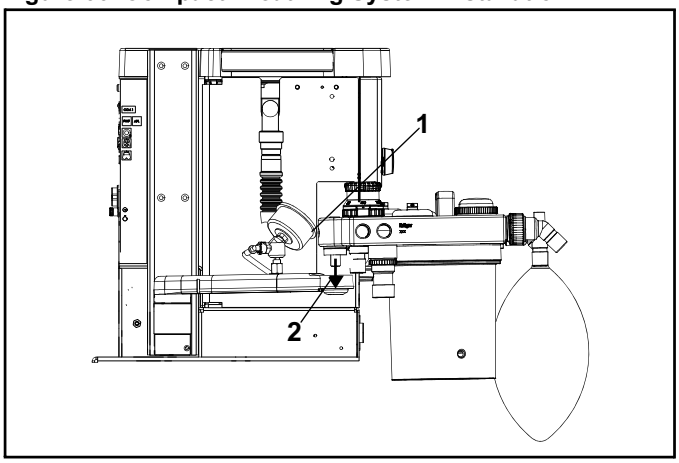
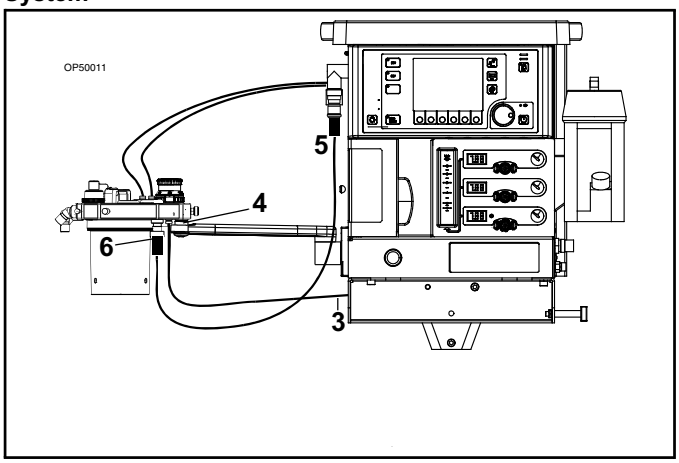



**Figure 67. Hose Connections for Compact Breathing System**



# Installation of HBSPS (Optional)

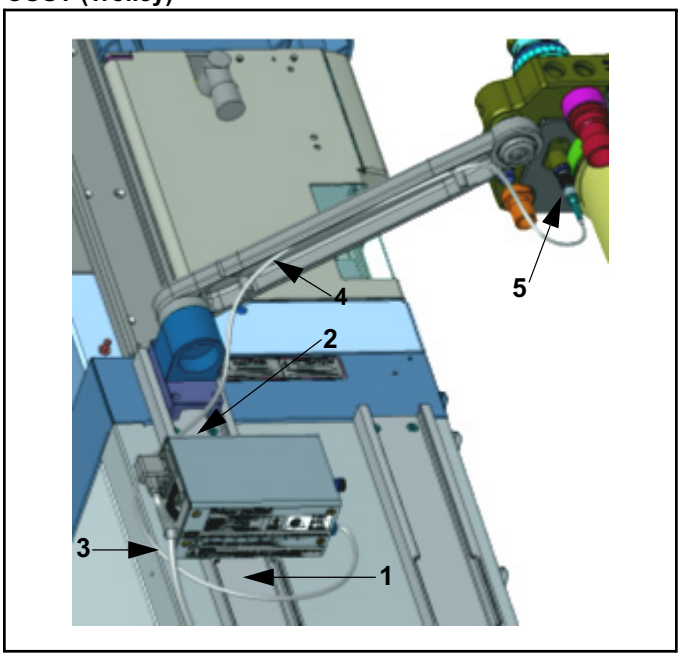
The following provides instruction on installation of the Heated Breathing System Power Supply (HBSPS).

## Left Mount COSY HBSPS Installation (Trolley)

The following numbers in boldface refer to Figure 68.

1. Install the power supply onto the left rear GCX rail of the Fabius Tiro by sliding the mounting plate of the power supply through the opening of the rail (**1**) and then sliding it upward. Tighten the knob (**2**) against the rail when the power supply is in the desired position.
2. Route the power cable (**3**) for the heater below and behind the power supply and then up to the rear of the COSY arm. Push the cable into the cable management cavity (**4**) on the bottom of the COSY arm.
3. Plug the connector at the end of the cable into the mating connector (**5**) on the rear underside of the COSY. Orient the connector so that the red mark on the connector plug aligns with the red mark on the receptacle.

**Figure 68. HBSPS Installation on Machine with Left Mount COSY (Trolley)**



## Right Mount COSY HBSPS Installation (Trolley)

1. Install the power supply onto the left rear GCX rail of the Fabius Tiro by sliding the mounting plate of the power supply through the opening of the rail (**1** in Figure 68) and then sliding it upward. Tighten the knob (**1** in Figure 69) against the rail when the power supply is in the desired position.
2. Route the power cable for the heater through the trough (**2** in Figure 69) on the rear of the cabinet. At the right hand end of the trough, route the cable into the cable management cavity (**1** in Figure 70) on the bottom of the COSY arm.
3. Plug the connector at the end of the cable into the mating connector (**2** in Figure 70) on the rear underside of the COSY. Orient the connector so that the red mark on the connector plug aligns with the red mark on the receptacle.

**Figure 69. HBSPS Installation on Machine with Right Mount COSY – Step 1 (Trolley)**

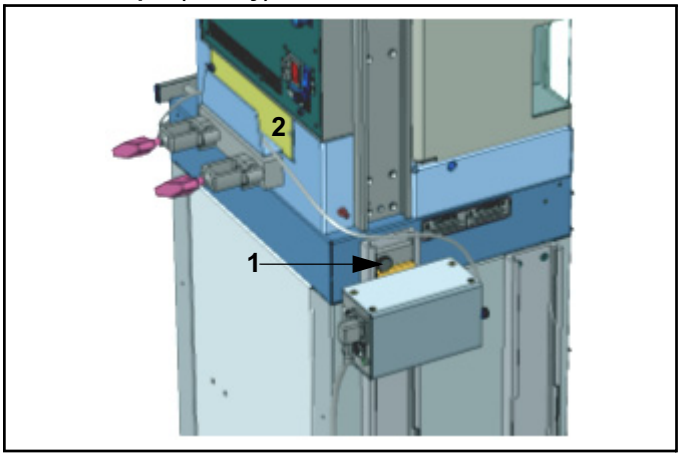
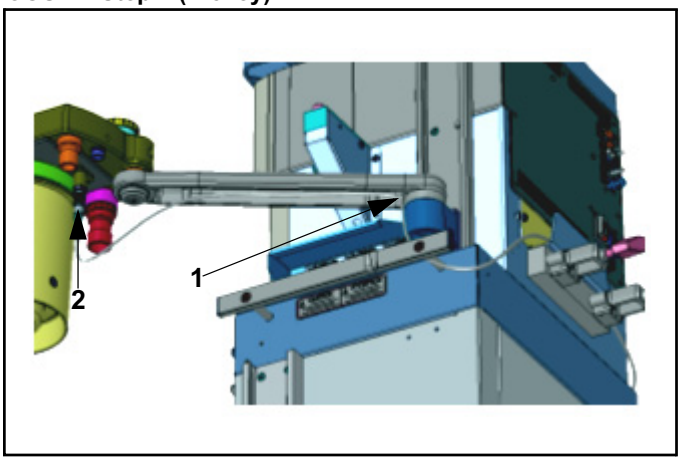


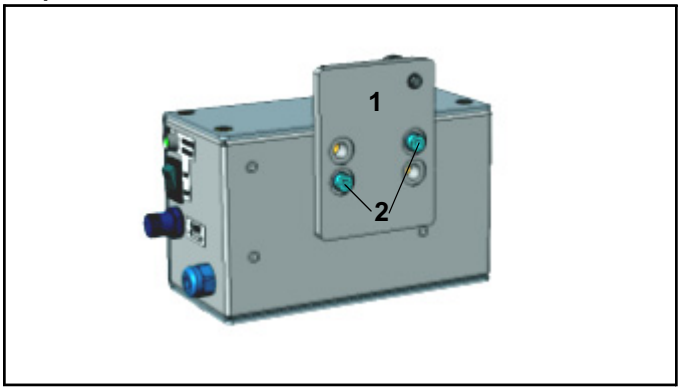

**Figure 70. HBSPS Installation on Machine with Right Mount COSY – Step 2 (Trolley)**



## Wall Mounted Machine HBSPS Installation

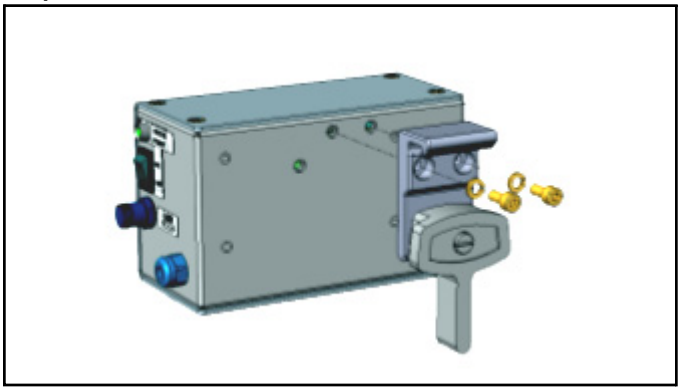
1. Remove the GCX slide plate (**1** in Figure 71) from the side of the power supply by removing the two screws (**2** in Figure 71).

**Figure 71. HBSPS Installation on Wall Mounted Machine – Step 1**



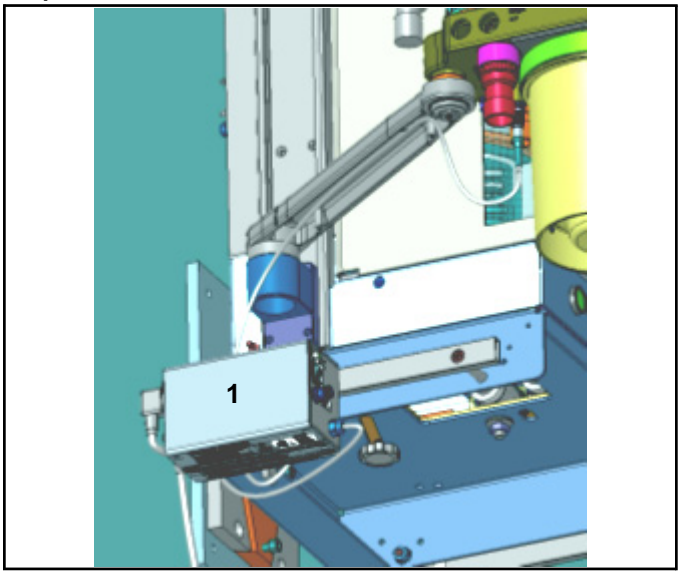

2. Install the Dräger clamp onto the rear side of the power supply box using the two screws and lockwashers included with the clamp assembly (Figure 72).

**Figure 72. HBSPS Installation on Wall Mounted Machine – Step 2**



3. Clamp the power supply onto the rear area of the left hand Dräger rail (**1** in Figure 73).

**Figure 73. HBSPS Installation on Wall Mounted Machine – Step 3**



### Left Mounted COSY HBSPS Wall Mounted Installation

4. On a left mounted COSY, route the power cable for the heater below and behind the power supply and then up to the rear of the COSY arm (**1** in Figure 74). Extra cable can be coiled around the clamp. Push the cable into the cable management cavity on the bottom of the COSY arm (**1** in Figure 75).
5. Plug the connector at the end of the cable into the mating connector on the rear, underside of the COSY (**2** in Figure 75). Orient the connector so that the red mark on the connector plug aligns with the red mark on the receptacle.

**Figure 74. HBSPS Installation on Wall Mounted Machine (Left Mount COSY) 1**

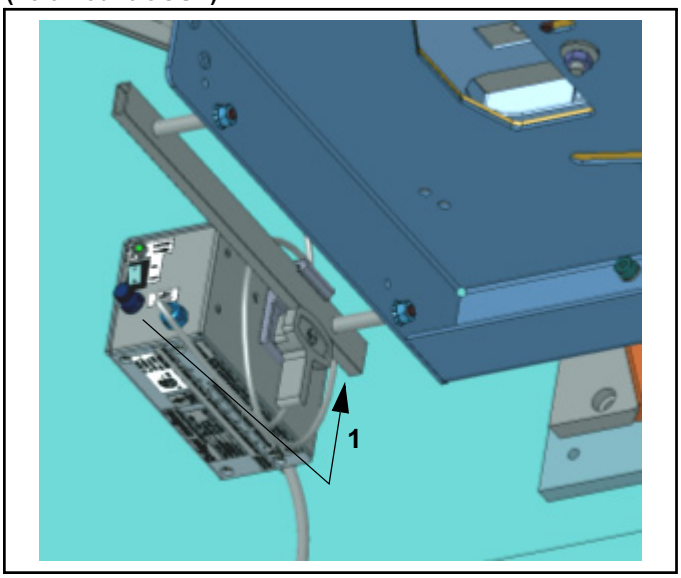
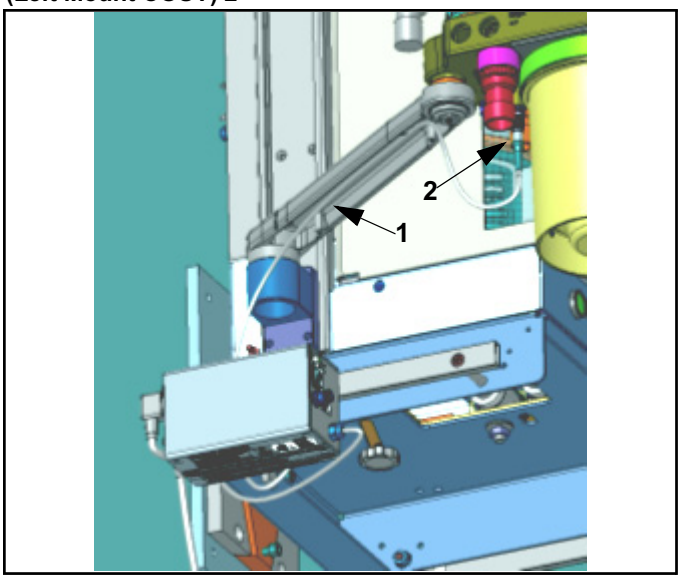


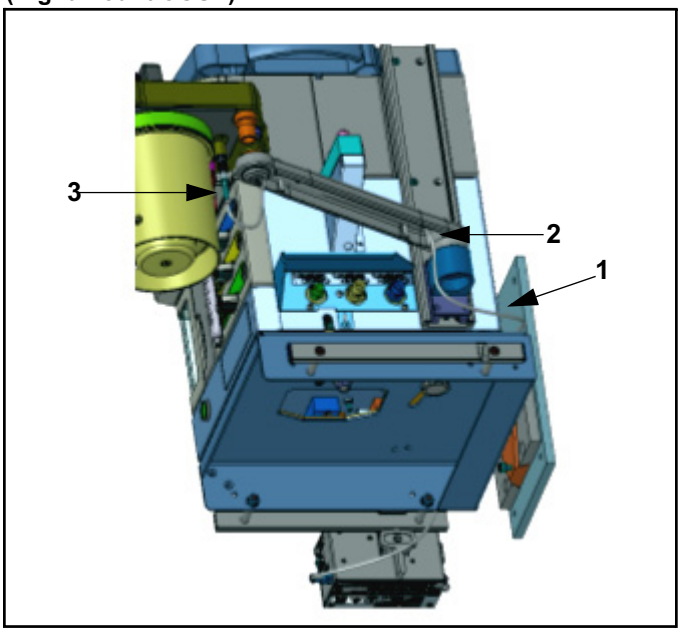

**Figure 75. HBSPS Installation on Wall Mounted Machine (Left Mount COSY) 2**



### Right Mounted COSY HBSPS Wall Mounted Installation

4. On a right mounted COSY machine, route the power cable for the heater through the trough on the rear of the cabinet (**1** in Figure 76). At the right hand end of the trough, route the cable into the cable management cavity on the bottom of the COSY arm (**2** in Figure 76).
5. Plug the connector at the end of the cable into the mating connector on the rear underside of the COSY (**3** in Figure 76). Orient the connector so that the red mark on the connector plug aligns with the red mark on the receptacle.

**Figure 76. HBSPS Installation on Wall Mounted Machine (Right Mount COSY)**



## Connecting the Breathing Hoses

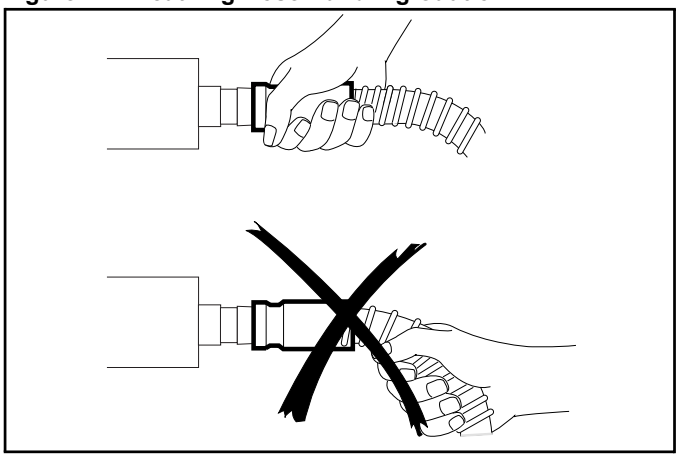
**Note:** Take care not to damage the breathing hoses.

When connecting and disconnecting, always hold the breathing hoses by the end sleeve, not by the spiral reinforcement (Figure 77). Otherwise, the spiral reinforcement may be torn loose.

Breathing hoses with a damaged spiral reinforcement can kink or become occluded.

Before each use, check the breathing hoses for damage.

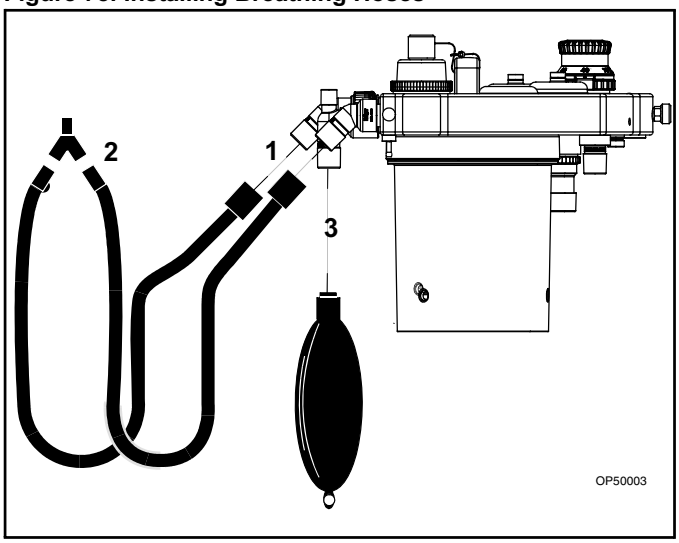
**Figure 77. Breathing Hose Handling Caution**



The following numbers in boldface refer to Figure 78.

1. Push patient breathing hoses (**1**) onto both the inspiratory and expiratory connectors or onto the microbial filters.
2. Connect both patient breathing hoses to the Y-piece (**2**).
3. Connect the bag (**3**) (or bag with hose) to the elbow port on the compact breathing system.

**Figure 78. Installing Breathing Hoses**



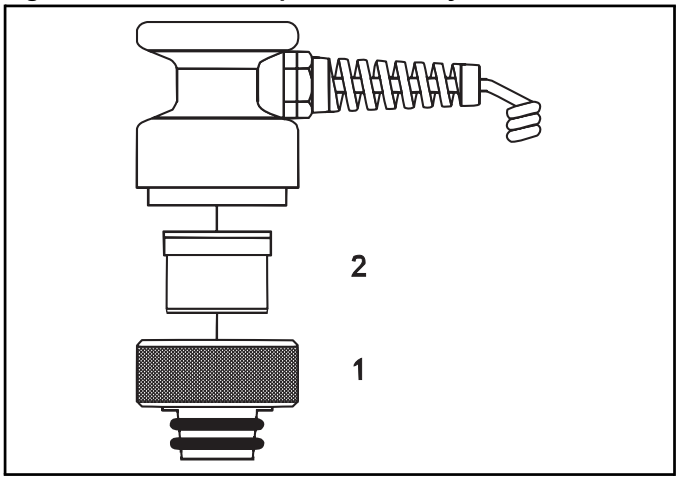

## Inserting A New $O_2$ Sensor Capsule

Inserting a new $O_2$ sensor capsule:

The following numbers in boldface refer to Figure 79.

1. Unscrew the cap (**1**) from the sensor housing.
2. Remove the new sensor capsule from its packaging.
3. Insert the capsule (**2**) in the housing, with the ring-shaped conductors against the contacts in the housing.
4. Screw the cap (**1**) on firmly by hand.

**Figure 79. $O_2$ Sensor Capsule Assembly**

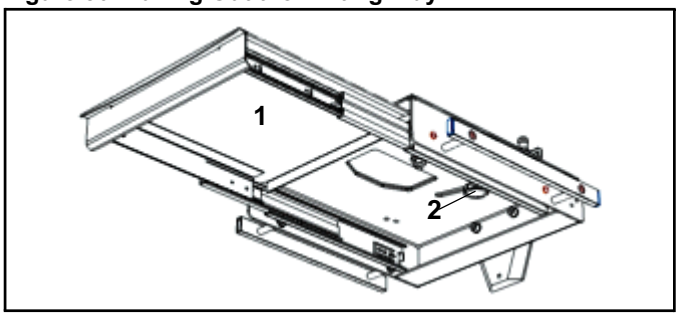


## Accessing the Connector Panel

The following bolded numbers refer to Figure 80.

1. Pull out the writing tray (**1**) to expose the swivel plate retention knob (**2**).

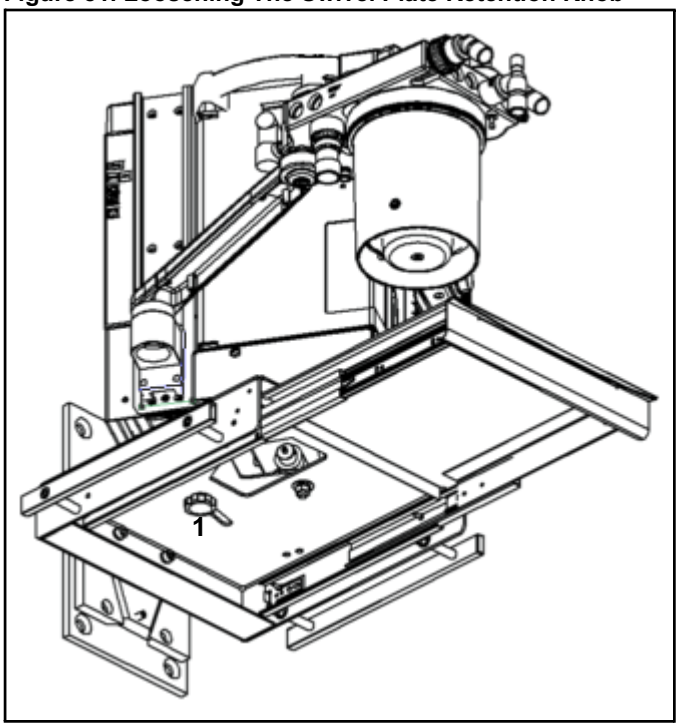
**Figure 80. Pulling Out the Writing Tray**




The following bolded numbers refer to Figure 81.

2. Turn the swivel plate retention knob (**1**) clockwise to loosen the Fabius Tiro module.
3. Rotate the Fabius Tiro module counterclockwise.

**Figure 81. Loosening The Swivel Plate Retention Knob**

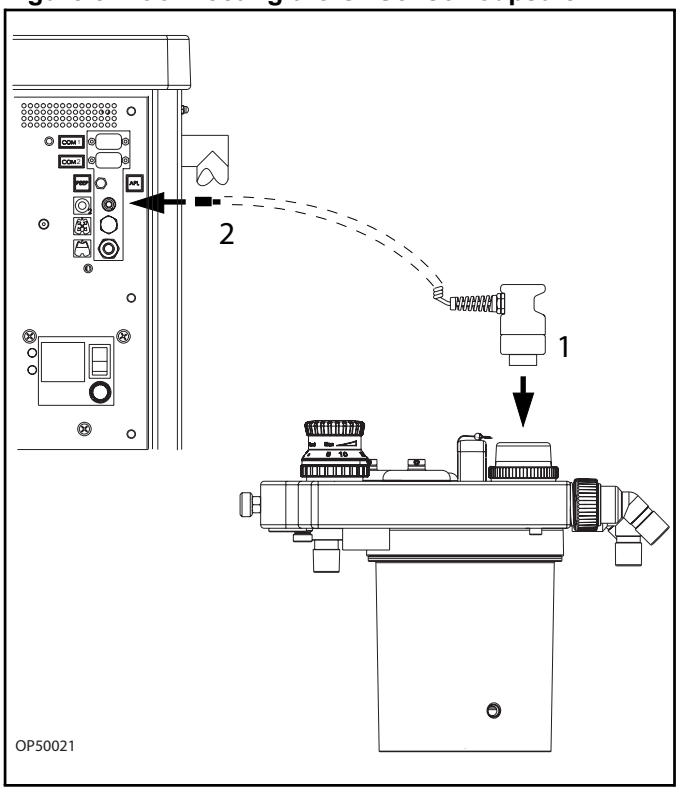


## Connecting the $O_2$ Sensor

The following numbers in boldface refer to Figure 82.

Push the $O_2$ sensor into the port opening of the inspiratory port dome (**1**), and plug the connector into the connector panel (**2**) where the $O_2$ label is shown:

**Figure 82. Connecting the $O_2$ Sensor Capsule**




## Connecting the Pressure Sensor

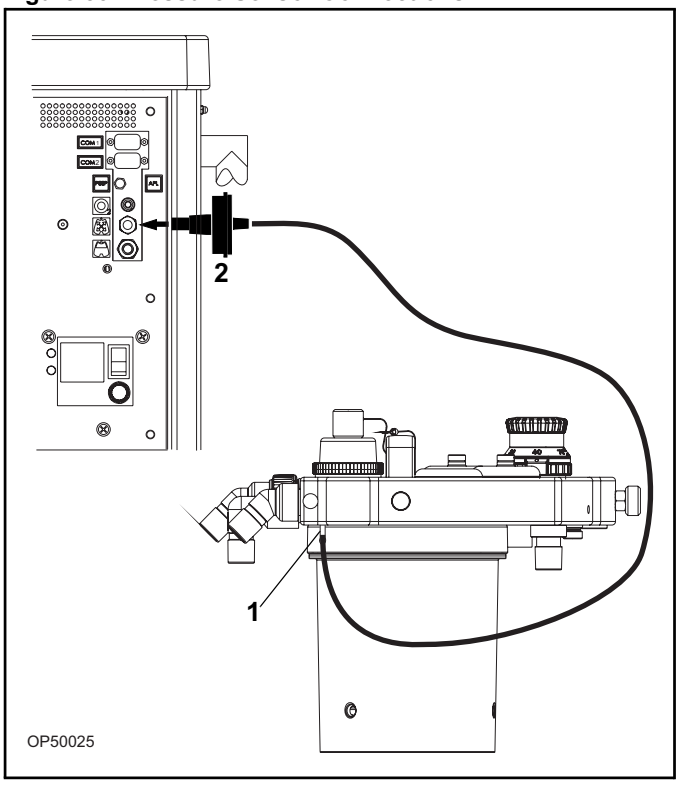
The following numbers in boldface refer to Figure 83.

Press the pressure measuring line hose onto the hose barb (**1**) until it engages.

**Caution:** Do not squeeze the pressure measuring line hose when pressing it onto the hose barb.

Connect the pressure measuring line hose to the bacterial filter (**2**) and plug it firmly onto the port on the connector panel where the pressure label is shown:

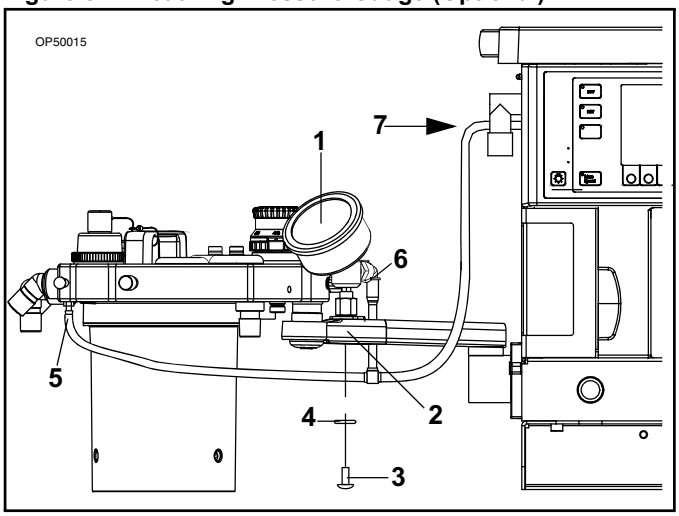
**Figure 83. Pressure Sensor Connections**



## Connecting the Breathing Pressure Gauge (Optional)

1. Connect the pressure gauge (**1**) to the compact breathing system mount (**2**) and secure with the retaining screw (**3**) and lockwasher (**4**).
2. Push the pressure measuring line hose onto the hose barb (**5**), the breathing pressure gauge port (**6**), and onto the port on the connector panel (**7**) where the pressure label is shown:

**Figure 84. Breathing Pressure Gauge (Optional)**



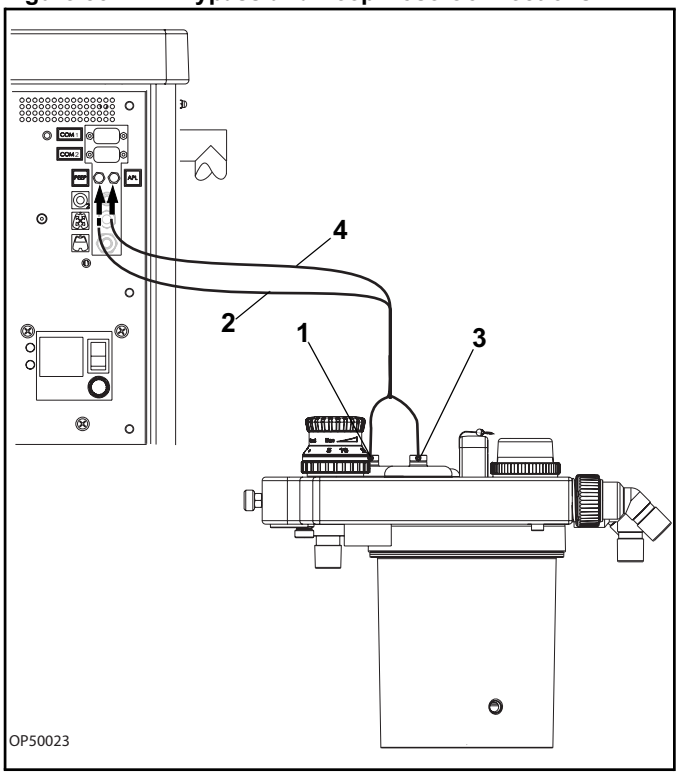

## Connecting the APL Bypass and Peep/PMAX Hoses

The following numbers in boldface refer to Figure 85.

1. Plug the control hose to the connection port on the PEEP/PMAX valve (**1**) and to the connection port marked “PEEP” on the connection panel (**2**).
2. Plug the control hose to the connection port on the APL Bypass valve (**3**) and to the connection port marked “APL” on the connection panel (**4**).

**Note:** The control hoses are connected together near the end of each hose. The APL bypass hose is larger than the PEEP/PMAX hose.

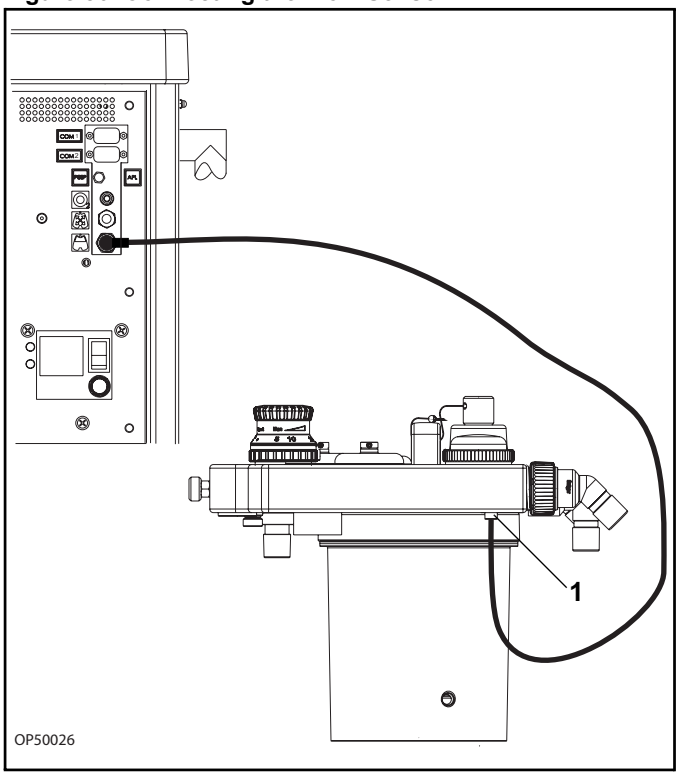
**Figure 85. APL Bypass and Peep Hose Connections**



## Connecting the Flow Sensor

Push the cable onto the connection port on the flow sensor (**1**).

**Figure 86. Connecting the Flow Sensor**



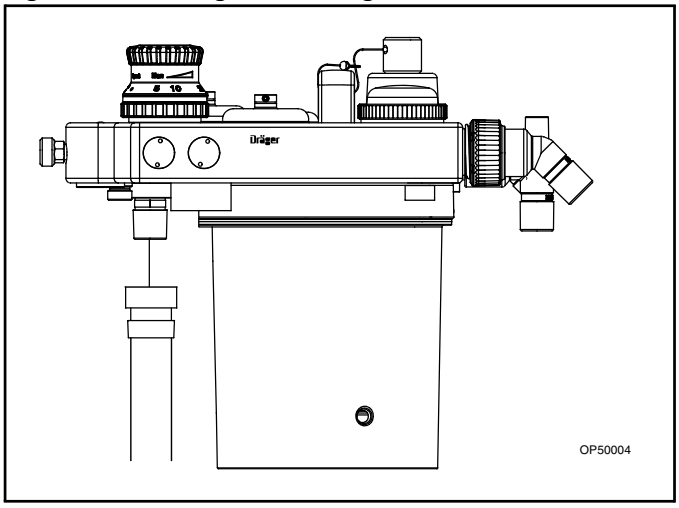

## Installing Anesthetic Gas Scavenging Hose to the Compact Breathing System

Connect the transfer hose to the waste gas port of the Compact Breathing System and to the anesthetic gas scavenging line or an anesthetic agent filter.

A second transfer hose is required for the Semi-open compact breathing system.

**Note:** Transfer hose with AGS (M33300) will be connected via cone adapter (30 mm) to waste gas port.

**Figure 87. Installing the Scavenger Transfer Hose**



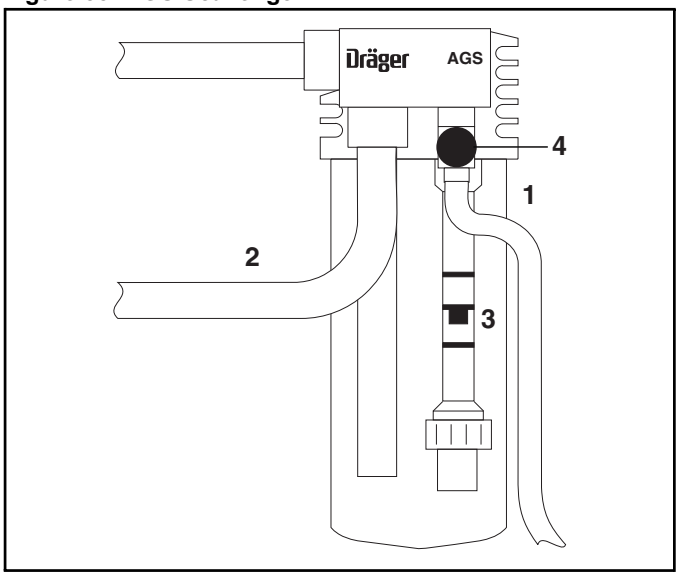
## Scavenger System for Fabius Tiro

The following numbers in boldface refer to Figure 88.

1. Output connection (**1**) from the scavenger system to the hospital waste gas removal system.
2. Connection to scavenger system (**2**) from Fabius Tiro breathing system.
3. Flow indicator (**3**). During use, the flow indicator must be between the upper and lower marks on the tube.
4. Flow adjustment valve (**4**).

For more detailed information on the scavenger system, refer to the separate specific Instructions for Use.

**Figure 88. AGS Scavenger**

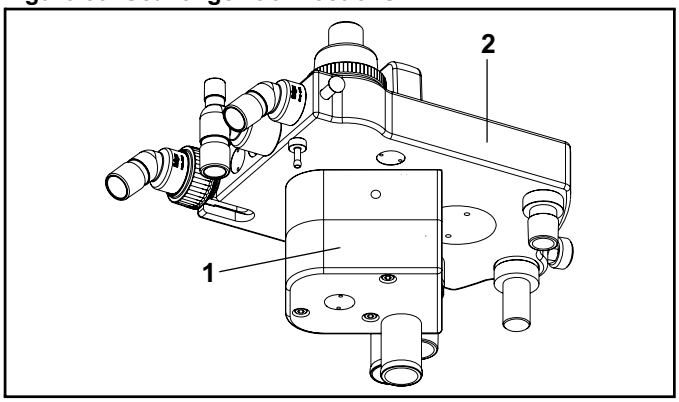



## Scavenger System Connections for the Semi-open Compact Breathing System

The following numbers in boldface refer to Figure 89.

Both exhaust ports (one on the semi-open adapter (**1**) and the other on the Compact Breathing System housing (**2**)) must be connected to the AGS scavenger. Remove the existing scavenger plug if necessary.

**Figure 89. Scavenger Connections**

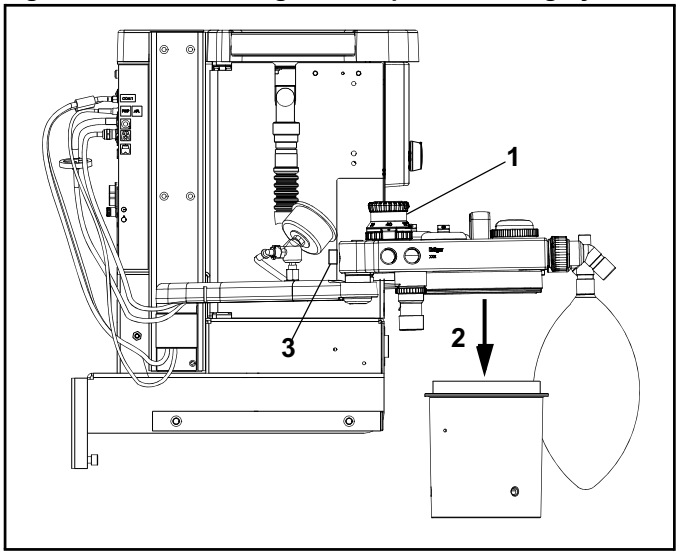



## Installation of the Semi-Open Adapter

The following numbers in boldface refer to Figure 90.

1. Disconnect the Fabius Tiro from the mains supply.
2. Disconnect the Fabius Tiro from the central pipeline gas supply.
3. Close all gas cylinders (if applicable).
4. Remove all hoses, sensors, and control lines from the Compact Breathing System.
5. Remove the APL valve (**1**).
6. Remove the absorbent canister (**2**) and store properly.
7. Pull and hold plunger (**3**) out to its full extension.

**Figure 90. Disconnecting the Compact Breathing System**



The following numbers in boldface refer to Figure 91.

8. Gently lift the breathing system and place upside down on a firm surface. It is recommended that it be placed on a soft surface such as a towel to prevent marring of the unit.
9. Remove the three mounting screws (**4**) (M5x16 mm) and washers that hold the canister mount to the compact breathing system housing.
10. Ensure that all “O” rings (**5**) are removed with the canister mount. Store this mount assembly, hardware, and “O” rings with the absorbent canister.

The following numbers in boldface refer to Figure 92.

11. Prepare the semi-open adapter and ensure that the “O” rings (**6**) are in the proper position. These “O” rings are provided with the adapter. Do not use the “O” rings from the compact canister mount, as they are not interchangeable.
12. Place the adapter onto the compact breathing assembly and secure with the three screws provided (M5x80 mm) (**7**) with the adapter. These screws each come with a flat washer (**9**) and four belleville washers (**8**). The belleville washers go on first followed by the flat washer. Please note that the belleville style washer is a curved spring washer and must be installed by opposing each other. Do not over tighten these screws.
13. Pull and hold plunger (**10**) out to its full extension and gently lift the compact breathing system.
14. Fit the compact breathing system onto the compact breathing system mount.
15. Release the plunger and rotate the compact breathing system until the plunger locks into position.
16. Connect all hoses, sensors, and control lines.
17. Install the APL valve.
18. Connect Fabius Tiro to the mains supply, and central pipeline gas supply.

**Figure 91. Removing the Compact Breathing System Mounting Plate.**

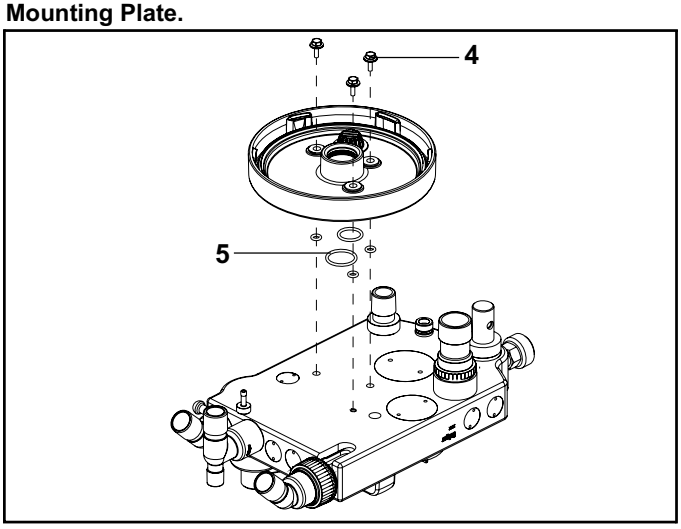
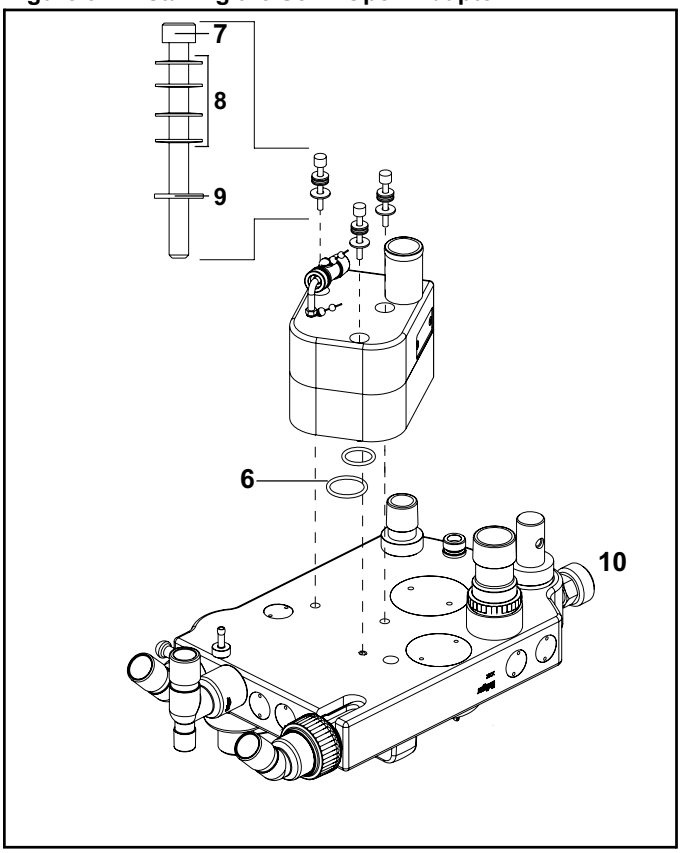



**Figure 92. Installing the Semi-Open Adapter**

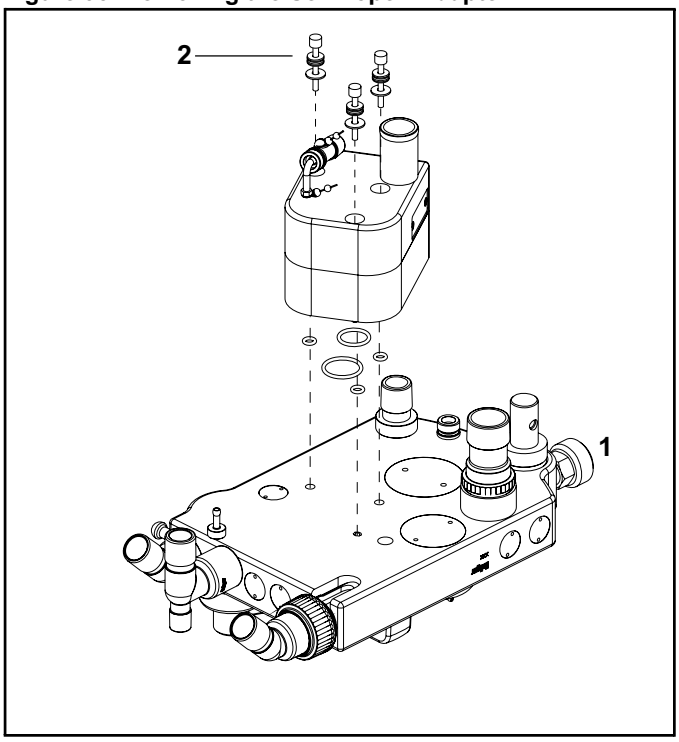


## Removing the Semi-Open Adaptor and Installing the $CO_2$ Absorber

The following numbers in boldface refer to Figure 93.

1. Disconnect the Fabius Tiro from the mains supply. Disconnect the Fabius Tiro from the central pipeline gas supply. Close all gas cylinders (if applicable).
2. Remove all hoses, sensors, and control lines from the Compact Breathing System.
3. Remove the APL valve.
4. Pull and hold plunger (**1**) out to its full extension.
5. Gently lift the breathing system and place upside down on a firm surface. It is recommended that it be placed on a soft surface such as a towel to prevent marring of the unit.
6. Remove the three mounting screws (M5x80mm) (**2**) and washers that hold the semi-open breathing system adapter to the compact breathing system housing.

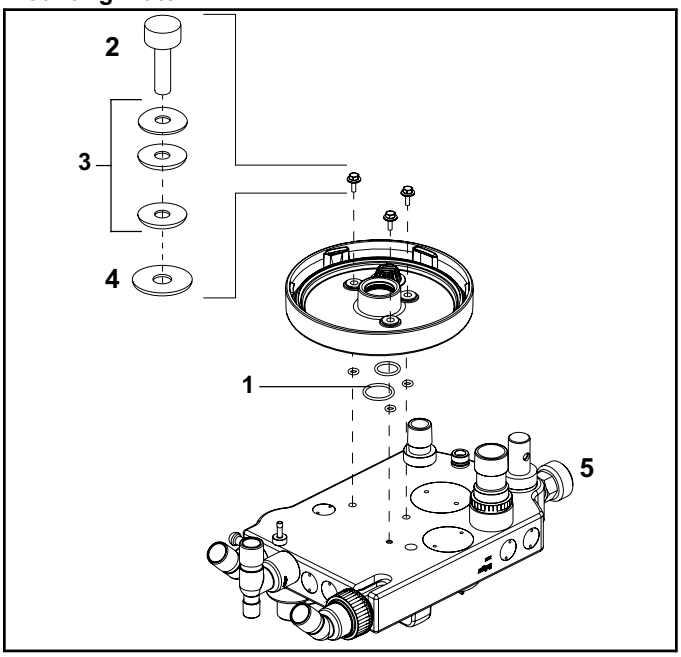
**Figure 93. Removing the Semi-open Adapter**




The following numbers in boldface refer to Figure 94.

7. Ensure that all five “O” rings (**1**) are in the proper position of the canister mount.
8. Install the three mounting screws (M5x16 mm) (**2**) and washers that hold the canister mount to the compact breathing system housing. There are three belleville washers (**3**) and a flat washer (**4**) for each mounting screw. Please note that the belleville style washer is a curved spring washer and must be installed by opposing each other. The flat washer is installed next. Do not over tighten these screws.
9. Pull and hold plunger (**5**) out to its full extension and gently lift the compact breathing system.
10. Fit the compact breathing system onto the compact breathing system mount.
11. Release the plunger and rotate the compact breathing system until the plunger locks into position.
12. Connect all hoses, sensors, and control lines.
13. Install the APL valve.
14. Connect Fabius Tiro to the mains supply and central pipeline gas supply.
15. Install the absorbent canister. Ensure that it is filled with fresh $CO_2$ absorbent.

**Figure 94. Installing the Compact Breathing System Mounting Plate**



## Additional Equipment

Prepare additional equipment as specified in the specific Instructions for Use.

**Caution:** If monitors and other equipment are placed on top of Fabius Tiro, the risk of tipping over the unit is increased, especially when rolling over thresholds etc.

Remove all monitors and other equipment from the top of the Fabius Tiro before moving the unit.

## Daily and Preuse Checkout Form

Complete the “Daily and Preuse Checkout Form” in Appendix A.

# Operation and Shut-down

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# Operation

## Power-Up Screen

When the SYSTEM POWER switch is turned to the ON position, the Fabius Tiro performs extensive self-tests on its internal hardware. As these diagnostics are performed, each test and its result appear on the screen. The result, Pass or Fail, indicates the status of the tested component. See Figure 95.

### Self-Diagnostic Conclusions

At the end of the self-diagnostics, one of three possible conclusions to the self-tests is posted on the screen (Figure 95).

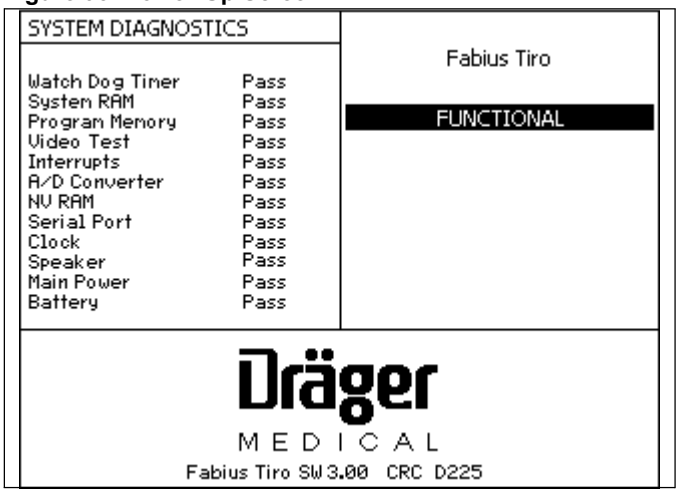
FUNCTIONAL
Every component of the monitoring system is in satisfactory operational order. After a brief delay, the Standby screen appears.

CONDITIONALLY FUNCTIONAL
A noncritical fault was detected. The Fabius Tiro may be used, but call DrägerService (see "Daily and Preuse Checkout Form" for DrägerService contact information).

Press the rotary knob to continue operation.

NON-FUNCTIONAL
A serious fault was detected and operation of the monitor and ventilator is inhibited. Do not use the machine. Immediately call DrägerService or DrägerService to correct the problem.

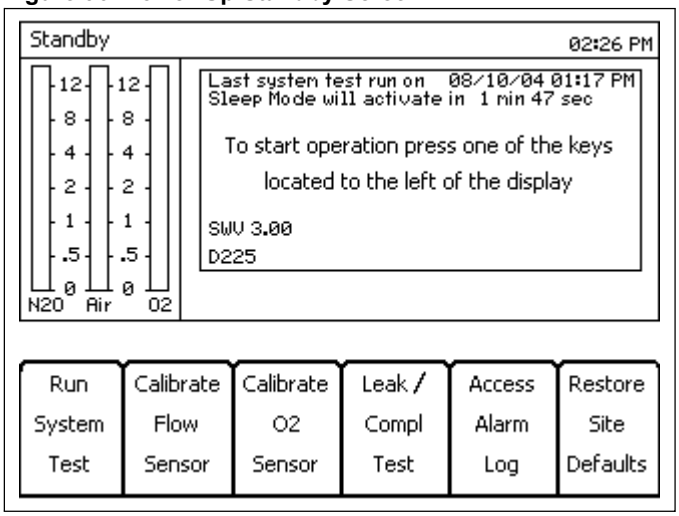
**Figure 95. Power-Up Screen**



## Power-Up Standby Screen

Following a successful power-up, the Standby screen appears (Figure 96) and provides instructions on starting the operation of the Fabius Tiro.

**Figure 96. Power-Up Standby Screen**

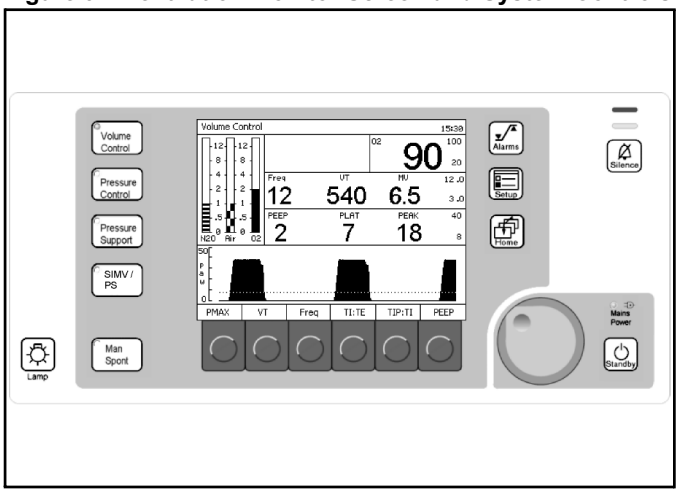



## Ventilation Monitor Screen

When the Fabius Tiro is in use, monitoring information is displayed on the Ventilation Monitor screen.

See “Operating Concept” on page 21 for an explanation of the Ventilation Monitor screen controls and windows.

**Figure 97. Ventilation Monitor Screen and System Controls**

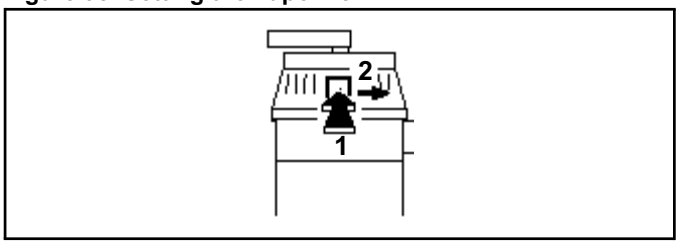



## Setting the Vaporizer

The following numbers in boldface refer to Figure 98.

1. Ensure that the vaporizer is properly seated and locked.
2. Press and hold down the 0 button (**1**) and turn the handwheel (**2**) counter-clockwise to the desired anesthetic agent concentration.
3. Regularly check the filling level on the sight glass. When reaching the minimum mark, fill the Vapor with anesthetic agent.
4. Please refer to the specific Instructions for Use for Dräger Vapor.

**Figure 98. Setting the Vaporizer**

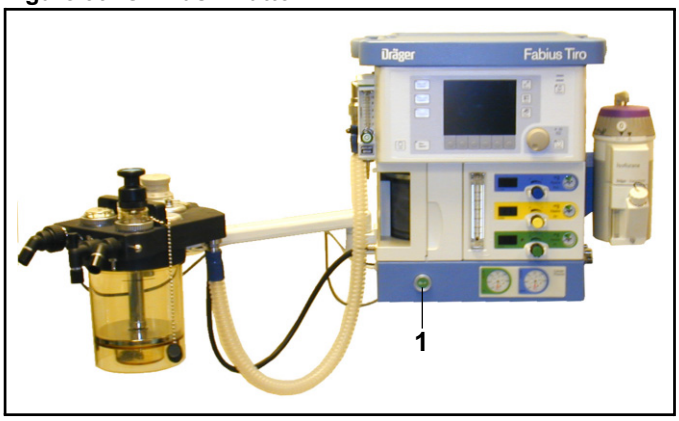


## $O_2$ Flush

1. Press the $O_2$ Flush button (**1** in Figure 99). Additional $O_2$ flows into the compact breathing system. The flow control elements and the anesthetic agent vaporizer are bypassed.

**Note:** In ManSpont mode, pressure may rise rapidly up to the setting of the APL valve.

**Figure 99. $O_2$ Flush Button**




## Minimum Flow of Anesthesia

When long-term flow of anesthesia is below 0.5 L/min, increased humidity in the ventilator hose is a natural occurrence. Disconnect the ventilator hose from the compact breathing system and clean before and after long term procedures. Use water traps in the expiratory hose. Empty water traps if their water level exceeds the maximum water level limit.

## Nitrogen Wash-out (When Required)

During anesthesia induction, air containing about 79% nitrogen ($N_2$) remains in the compact breathing system (and in the patient's lungs). If the unit will be used for a low-flow anesthesia case, press the $O_2$ Flush to remove this $N_2$.

## Replacing $CO_2$ Absorbent

The $CO_2$ absorbent in the compact breathing system should be replaced when two-thirds of the $CO_2$ absorbent has changed color. Dräger recommends the use of Drägersorb® 800 Plus or Drägersorb® FREE. The color change indicates that the $CO_2$ absorbent can no longer absorb $CO_2$ (Drägersorb® 800 Plus or Drägersorb® FREE changes from white to violet).

Do not flush $CO_2$ absorbent for long periods with dry gas because the $CO_2$ absorbent will dry out.

**Warning:** When the moisture content falls below a specified minimum level, the following undesirable reactions can occur, regardless of the type of $CO_2$ absorbent and the anesthetic agent used, e.g. Halothane, Enflurane, Isoflurane, Sevoflurane or Desflurane:

- reduced $CO_2$ absorption,
- formation of CO,
- absorption and/or decomposition of the inhalation anesthetic agent,
- increased heat generation in the absorber, leading to higher breathing gas temperatures.

Additionally, the breakdown products of anesthetic agents exposed to dry absorbent are both flammable and toxic, and fires have been reported in association with the use of desiccated absorbent and volatile anesthetics.

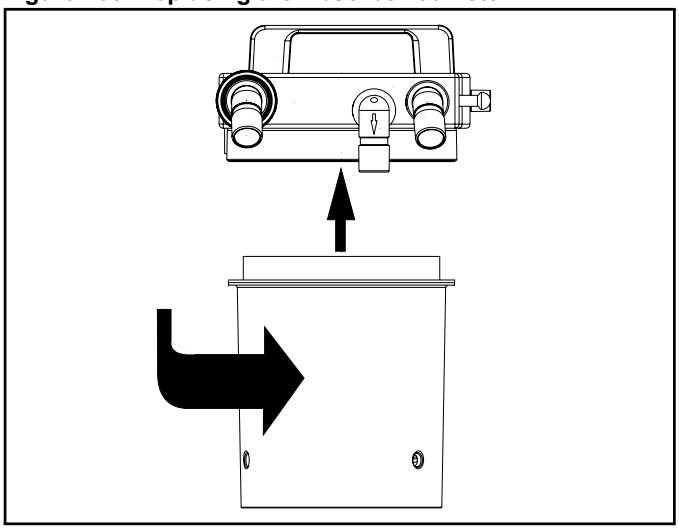
These reactions can result in danger to the patient in the form of CO intoxication, insufficient depth of anesthesia and airway burns.

**Note:** Please refer to the specific Instructions for Use for “Drägersorb® 800 Plus” or “Drägersorb® FREE”.

Dräger recommends that absorbent be changed, regardless of color, if the anesthesia machine has been idle for 48 hours or more. Further, Dräger recommends that it be changed at the beginning of the work week.

**Warning:** Absorbent is caustic and is a strong irritant to the eyes, skin, and respiratory tract. When replacing the absorbent, take care not to spill its caustic contents.

**Figure 100. Replacing the Absorber Canister**



1. Empty the expired $CO_2$ absorbent from the absorber into an appropriate refuse container.
2. Fill the absorber with fresh $CO_2$ absorbent.

**Note:** Ensure that no $CO_2$ absorbent dust/particles have been deposited between the gaskets and sealing surfaces. Such dust and particles can cause leaks in the system.

Dräger recommends the use of Drägersorb® 800 Plus or Drägersorb® FREE.

## Power Failure Backup

When AC power is interrupted from the Fabius Tiro, the internal battery backup will provide full operation of the ventilator and internal monitors for up to two hours after the power interruption. The battery depletion rate depends upon ventilator settings and the condition of the battery (age and level of charge), but under no circumstances should a fully charged battery provide less than 45 minutes of full functionality.

**The auxiliary sockets are not powered by the uninterruptable power supply (UPS) in the event of a power failure!**

The transition to battery-powered operation will not interrupt any machine functions. At the transition, and as the battery is discharged, the following information will be displayed:

- The battery symbol ( ) appears in the status bar and the Mains Power LED turns off.
- The “POWER FAIL!” Advisory alarm message is displayed in the alarm window.
- When the battery is discharged to 20% of its reserve power, the “BATTERY LOW!” Advisory alarm message is displayed in the alarm window.
- When the battery is discharged to 10% of its reserve power, the “BATTERY LOW!!” Caution alarm message replaces the Advisory alarm message in the alarm window.
- When the battery is almost fully discharged, the ventilator will stop and the Ventilator Fail Warning alarm message (VENTILATOR FAIL!!!) is displayed in the alarm window.
  If manual ventilation is not provided, the Apnoea Pressure Warning (APNOEA PRESSURE!!!), Apnoea Flow Warning (APNOEA FLOW!!!), and Minute Volume Low Caution (MINUTE VOLUME LOW!!) alarm messages are displayed in the alarm window.
- The internal monitors continue to operate until the battery is completely discharged and all electronics are shut down.

**Warning:** When the “BATTERY LOW!!” Caution alarm message is first displayed, the ventilator will continue to operate for up to an additional 10 minutes. Then, automatic ventilation is not available until AC power is restored.

**Caution:** Never allow the battery to completely discharge. If the battery does discharge completely, recharge immediately.

When the battery is completely discharged, all pneumatic functions of the Fabius Tiro continue to be available (APL valve, breathing pressure gauge, cylinder and pipeline gauges, fresh gas and agent delivery, S-ORC, and total flowmeter). Manual or spontaneous ventilation can be maintained.

## Ventilator Fail State

The ventilator automatically switches to ManSpont Mode if the Fabius Tiro detects an internal fault. The clinician is alerted that ManSpont Mode has been initiated by a VENTILATOR FAIL warning message and audible alarm.

The ventilator now performs in ManSpont Mode.

1. Set the APL valve to MAN position.
2. Adjust the APL pressure limit for the desired inspiratory plateau pressure.
3. Press the $O_2$ flush button on the Fabius Tiro as required to sufficiently inflate the breathing bag.
4. Manually ventilate the patient by squeezing the breathing bag.

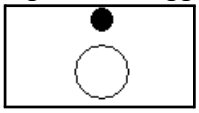
   **Note:** In the ventilator fail situation, the ventilator piston assembly position may not be locked. As a result, airway pressure may initially push the piston back to its limit stop, increasing the volume of the breathing circuit. It may be necessary to press the $O_2$ flush button again to reinflate the breathing bag.

## Overriding the Ventilator

In the unlikely event of a fault in which the ventilator does not automatically switch to manual ventilation mode, and the user cannot switch to manual ventilation mode through the use of the keypad and rotary knob, manual ventilation is still possible.

1. Locate the system power switch on the rear panel.
2. Toggle the system power switch to “off” (Figure 101) and then

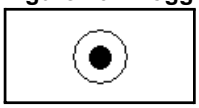
**Figure 101. Toggle Power Switch to Off Label**



3. Toggle the system power switch back to “on” (Figure 102).

   The ventilator now performs as in ManSpont mode.

**Figure 102. Toggle Power Switch to On Label**



4. Set the APL valve to MAN position.
5. Adjust the APL pressure limit for the desired inspiratory plateau pressure.
6. Press the $O_2$ flush button on the Fabius Tiro as required to sufficiently inflate the breathing bag.
7. Manually ventilate the patient by squeezing the breathing bag.

   **Note:** After toggling the main power switch, the Fabius Tiro will perform its diagnostic tests. During the diagnostic tests, manual ventilation is possible. If the diagnostic tests result in “FUNCTIONAL”, the Fabius Tiro will automatically switch to ManSpont mode if fresh gas flow is detected. Fabius Tiro respiratory monitoring is available. If the diagnostic tests result in NON-FUNCTIONAL, Manual ventilation is still possible but Fabius Tiro respiratory monitoring is not available.

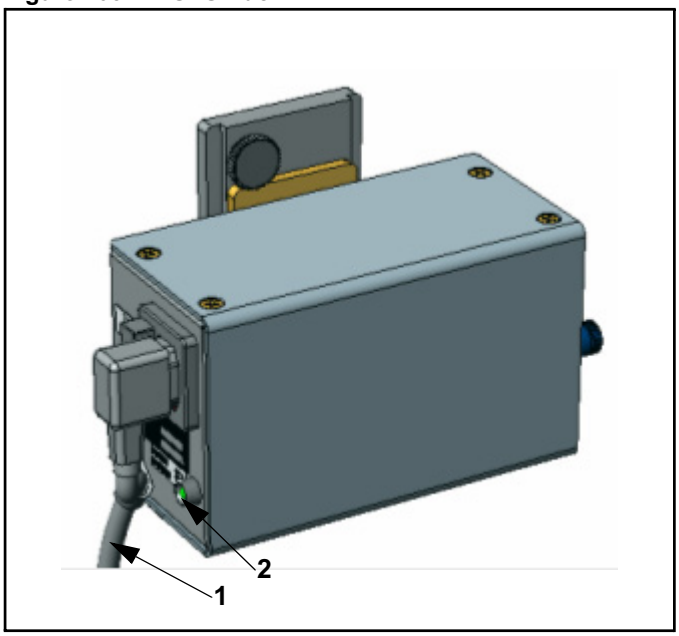
   **Note:** In ventilator override situation the ventilator piston assembly position may not be locked, as in ManSpont mode. As a result, airway pressure may initially push the piston back to its limit stop, increasing the volume of the breathing circuit. It may be necessary to press the $O_2$ flush button again to reinflate the breathing bag.

8. Contact DrägerService before using the ventilator.

## Operation of HBSPS (Optional)

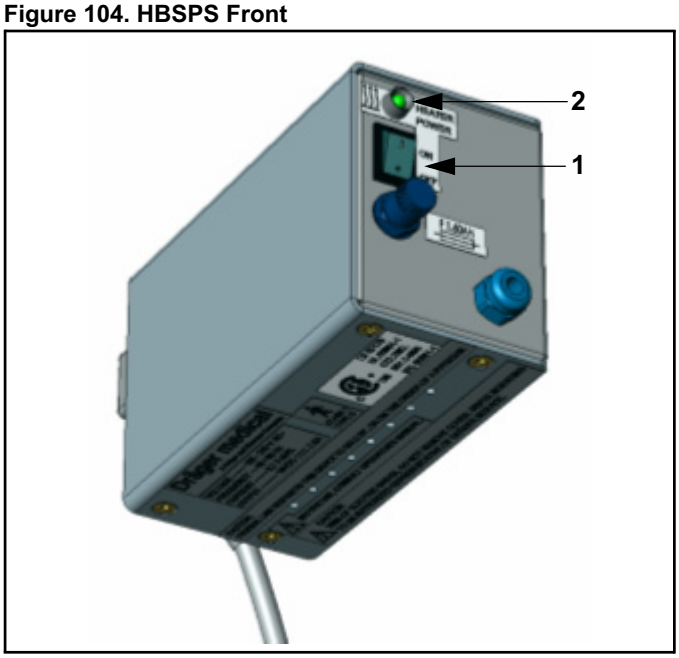
1. Plug the power cord (**1** in Figure 103) into a mains power outlet on the wall. The green LED for MAINS POWER (**2** in Figure 103) will illuminate when the plug is connected to power.
2. Switch the HEATER POWER switch (**1** in Figure 104) to the ON position (top of the rocker depressed). The HEATER POWER LED will illuminate (**2** in Figure 104).
3. After 15 to 30 minutes, the underside of the COSY will feel slightly warm.

**Figure 103. HBSPS Back**




To avoid the possibility of drying out absorbent, it is recommended that the heater be turned off when not in use.

**Figure 104. HBSPS Front**




**Warning:** When the moisture content falls below a specified minimum level, the following undesirable reactions can occur, regardless of the type of $CO_2$ absorbent and the anesthetic agent used, e.g. Halothane, Enflurane, Isoflurane, Sevoflurane or Desflurane:

- reduced $CO_2$ absorption,
- formation of CO,
- absorption and/or decomposition of the inhalation anesthetic agent,
- increased heat generation in the absorber, leading to higher breathing gas temperatures.

Additionally, the breakdown products of anesthetic agents exposed to dry absorbent are both flammable and toxic, and fires have been reported in association with the use of desiccated absorbent and volatile anesthetics.

These reactions can result in danger to the patient in the form of CO intoxication, insufficient depth of anesthesia and airway burns.

### HBSPS Problem Resolution

**Note:** Call DrägerService or your local Authorized Service Organization of the following steps do not resolve HBSPS problems.

Bottom of COSY Not Warm After 30 Minutes

1. Ensure that the HEATER POWER switch (**1** in Figure 105) is in the ON position.
2. Ensure that the “HEATER POWER ON” LED is illuminated (**2** in Figure 105).
3. Check that the connector (**1** in Figure 106) on the cable running to the COSY is plugged in properly.
4. Check that the MAINS POWER LED (**1** in Figure 107) is illuminated and that the Mains Power cord (**2** in Figure 107) is plugged into a functioning wall outlet.

“HEATER POWER ON LED” Is Not Illuminated

If the “HEATER POWER ON” LED (**2** in Figure 105) is not illuminated when the HEATER POWER switch (**1** in Figure 105) is in the ON position and the MAINS POWER LED (**1** in Figure 107) is illuminated, check the fuse (**3** in Figure 105). If it is blown, replace it with the properly rated fuse.

MAINS POWER LED Is Not Illuminated

If the MAINS POWER LED (**1** in Figure 107) is not illuminated when the mains power cord (**2** in Figure 107) is plugged into a wall outlet:

1. Check that the wall outlet is functioning and the plug is plugged into it properly.
2. Check that the power supply-end cord plug (**4** in Figure 107) is plugged into the power supply properly.
3. Check the two fuses in the power inlet assembly (**3** in Figure 107). Replace them if they are blown.

**Figure 105. HBSPS Front**

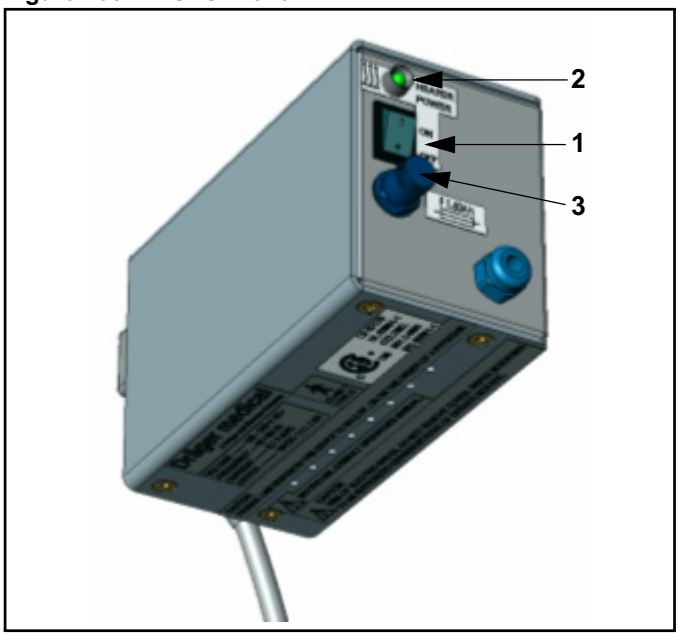



**Figure 106. HBSPS Connector**

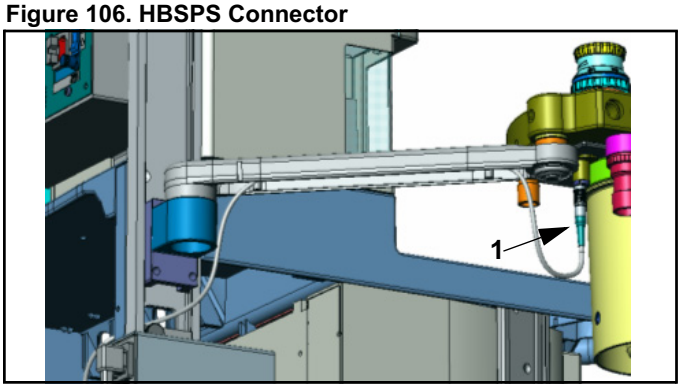
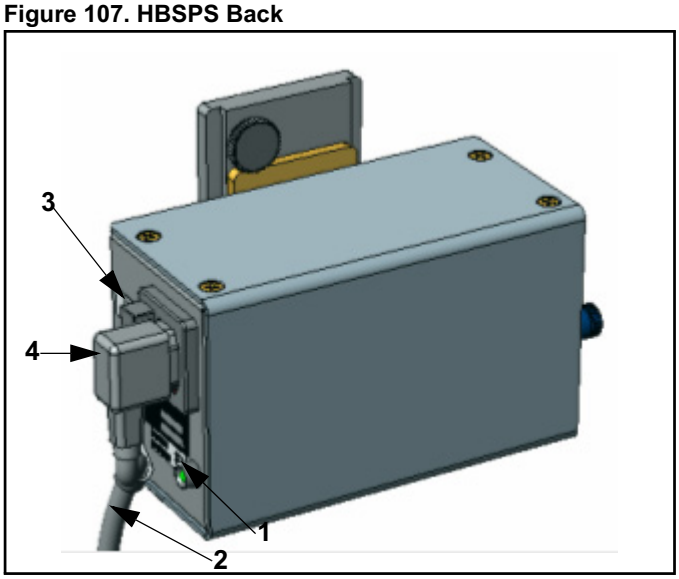



**Figure 107. HBSPS Back**



# Preparation for Transport or Storage

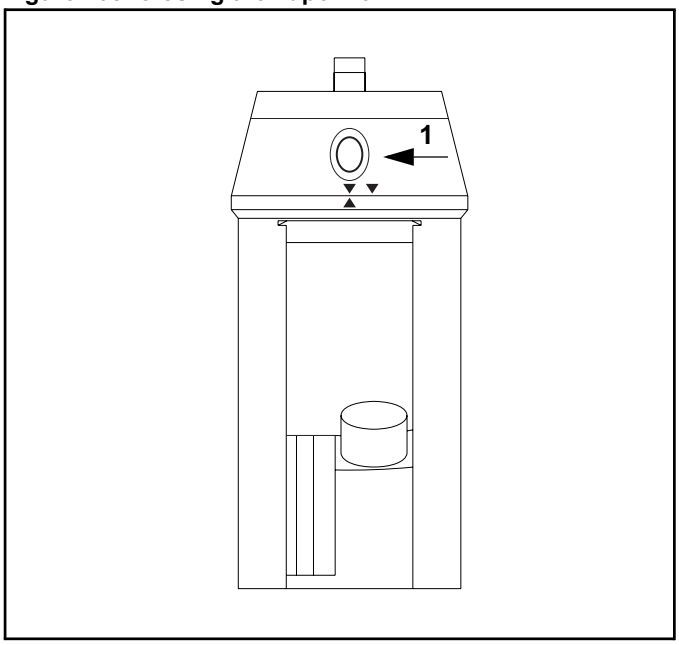
**Warning:** When moving the anesthesia machine, remove all monitors and equipment from the top shelf, remove the absorber system, and use only the machine handles to push or pull the unit. The anesthesia machine should only be moved by people who are physically capable of handling its weight. Dräger recommends that two people move the anesthesia machine to aid in maneuverability. Exercise special care so that the machine does not tip when moving up or down inclines, around corners, and across thresholds (for example, in door frames and elevators). Do not attempt to pull the machine over any hoses, cords, or other obstacles on the floor.

## Switch Off the Anesthetic Agent Vaporizer

**(Dräger Vapor)**

Turn the handwheel (**1** in Figure 108) to 0 until the button engages.

**Figure 108. Closing the Vaporizer**

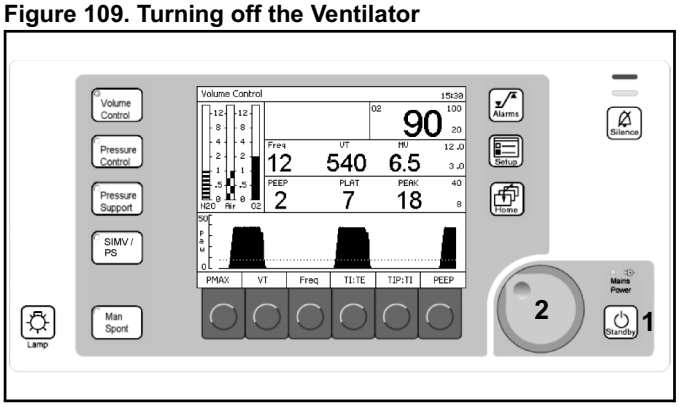


## Switching Off the Ventilator

The following numbers in boldface refer to Figure 109.

1. Switch the anesthesia ventilator to standby by pressing the Standby button (**1**).
2. Confirm by pressing the rotary knob (**2**). Fabius Tiro is now in standby mode.

**Figure 109. Turning off the Ventilator**



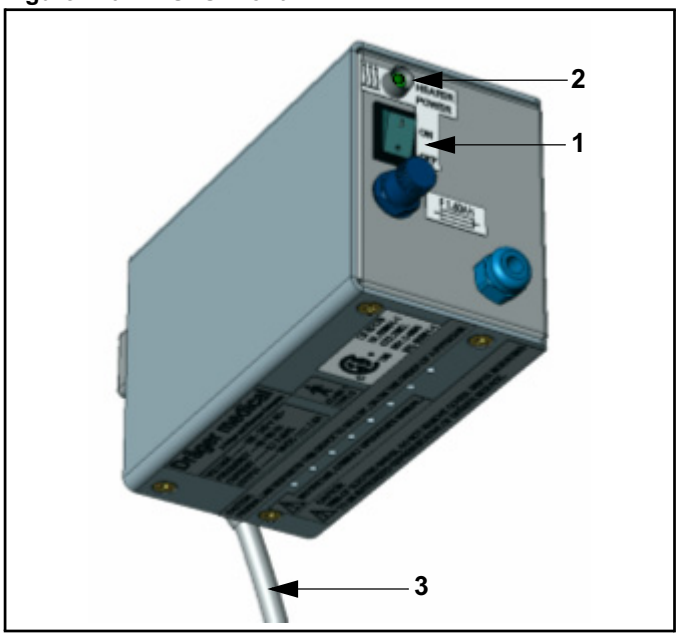

## Remove the $O_2$ Sensor

Remove the $O_2$ sensor from the inspiratory valve and leave exposed to air. This precaution prolongs the service life of the $O_2$ sensor.

## Switching Off HBSPS (Optional)

1. Switch the HEATER POWER switch (**1** in Figure 110) to the OFF position (bottom of the rocker depressed). The HEATER POWER LED will darken (**2** in Figure 110).
2. Unplug the power cord (**3** in Figure 110) from the mains power outlet on the wall.

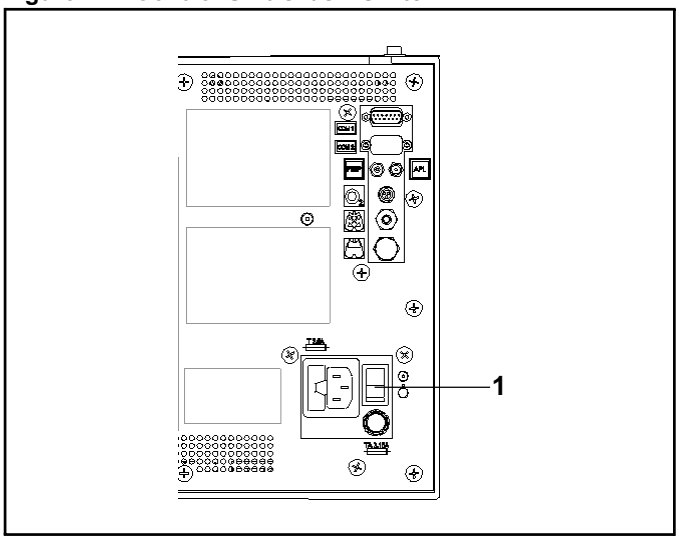
**Figure 110. HBSPS Front**



## Switch Off System Power

Switch off the unit using the switch at the back (**1**) and disconnect the power plug.

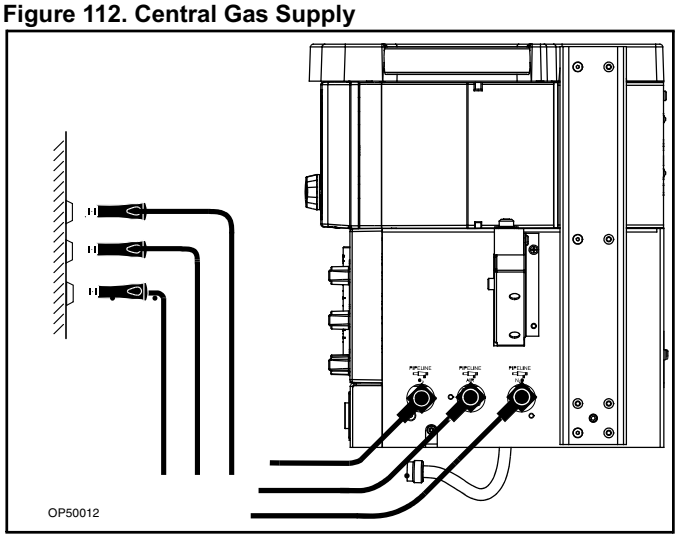
**Figure 111. Control Unit On/Off Switch**




## Disconnect the Central Gas Supply

1. Remove all plug-in couplings from the wall terminal units.
2. Close gas cylinders.
3. Press the $O_2$ Flush to depressurize the entire system.

**Figure 112. Central Gas Supply**



# Monitoring

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# Overview

This chapter describes functions that are specific to oxygen monitoring, respiratory volume monitoring, and breathing pressure monitoring. For information on general monitoring functions, see “Operating Concept” on page 21.

# Alarms

## Setting Alarm Limits

The Alarm Limits key enables you to set alarm limits for the present procedure.

To set the default alarm limits that take effect at power-up, see “Setting Alarm Limit Defaults” on page 127.

## Alarm Limits Key

The Alarm Limits key is shown at **1** in Figure 113.

Displays the Alarm Limits window (**1** in Figure 114).

Use the select and confirm process outlined in “Selecting/Setting Monitoring Functions” on page 28 to change the alarm limits on the Alarm Limits window.

**Figure 113. Ventilation Monitor Screen and System Controls**

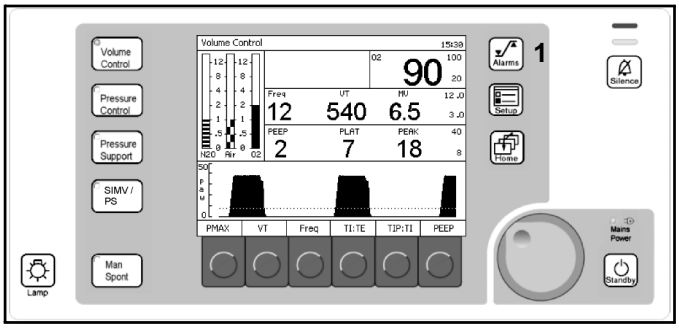
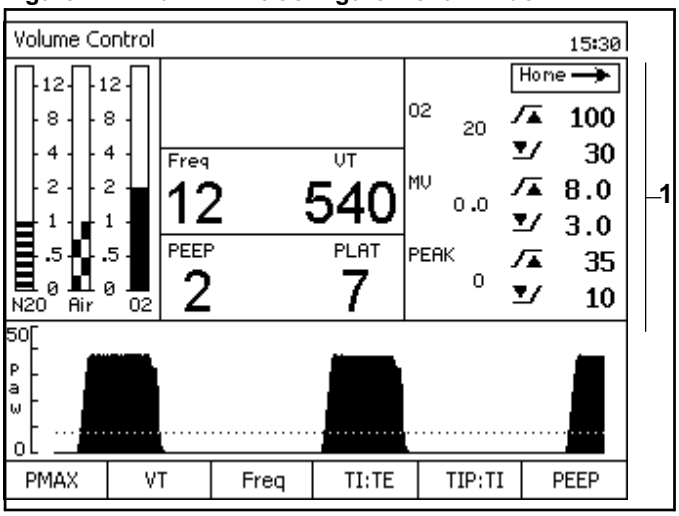



**Figure 114. Alarm Limit Configure Menu Window**




## Alarm Tones

The alarm tones provide an audible alert to the message displays. Each message is assigned a tone or sequence of tones to indicate its degree of urgency.

- Warning (continuous)
- Caution (every 30 seconds)
- Advisory (single signal or no tone for selected advisories only)

## Alarm Text Display Convention

- Warnings are followed by three exclamation marks (!!!).
- Cautions are followed by two exclamation marks (!!).
- Advisories are followed by one exclamation mark (!).

# Oxygen Monitoring

## $O_2$ Monitoring Disabled

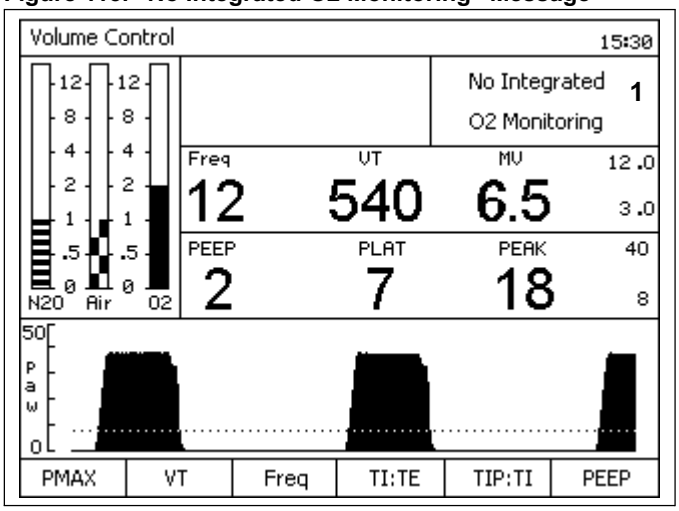
The following oxygen monitoring functions are disabled if the Fabius Tiro is configured by DrägerService to run using the "$O_2$ Monitoring Disabled" option.

- "Oxygen Monitor Window" on page 93
- "Setting Oxygen Alarm Limits" on page 93
- "Calibrating the Oxygen Sensor" on page 94
- Fabius Tiro-generated inspiratory $O_2$ and $O_2$ sensor alarms.

**Note:** If internal $FiO_2$ monitoring is deactivated, external $FiO_2$ monitoring must be available.

**Note:** The message "No Integrated $O_2$ Monitoring" is displayed in the oxygen monitor window (**1** in Figure 115) when $O_2$ monitoring is disabled.

**Figure 115. "No Integrated O2 Monitoring" Message**




## Oxygen Monitoring Overview

Inspiratory oxygen concentration is measured with a dual galvanic cell sensor, which is attached to the inspiratory valve dome. The sensor contains two independent electrochemical cells, or sensor halves. When the sensor is exposed to oxygen, an electrochemical reaction occurs within each cell. The oxygen monitor measures the current produced in each cell, computes an average for the two cells, and translates the average into an oxygen concentration measurement.

**Caution:** Never remove an oxygen sensor from its housing, except to replace it. If a sensor is removed from its housing, you must do the following before continuing normal operations:

- Reinstall the sensor in the housing.
- Calibrate the sensor.

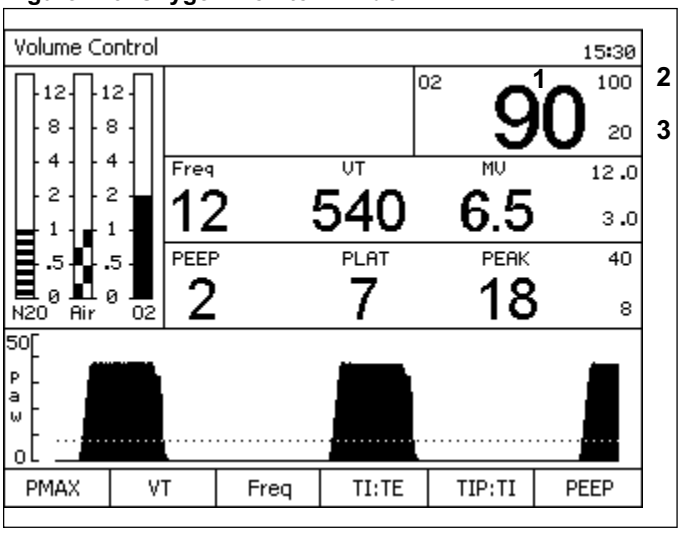
**Note:** When the machine is not in use, remove the oxygen sensor assembly from the inspiratory valve dome, and insert the valve dome plug into the dome.

## Oxygen Monitor Window

The following numbers in boldface refer to Figure 116.

- **1** – the numerical value for inspiratory oxygen concentration in units of percent (%) between 10% and 100%
- **2** – the high oxygen concentration alarm limit
- **3** – the low oxygen concentration alarm limit

**Figure 116. Oxygen Monitor Window**

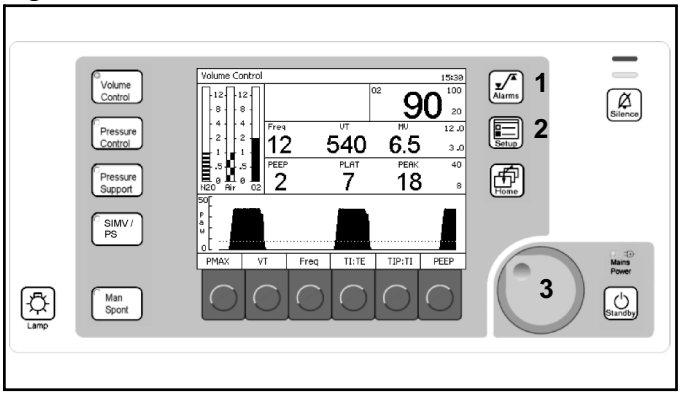



## Oxygen Monitor Controls

The following numbers in boldface refer to Figure 117.

You use the Alarm Limits key (**1**), Setup key (**2**), and rotary knob (**3**) to set oxygen concentration alarm limits and calibrate the oxygen sensor.

**Figure 117. Monitor Controls**




## Setting Oxygen Alarm Limits

At power-up, the oxygen high and low alarm limits are automatically set to their default settings (See “Default Settings” on page 124 for more information). You can adjust these limits within specified ranges.

### Oxygen Alarm Limits

Oxygen High Limit
The Oxygen High Alarm Limit range is from 19% to 100%. The Oxygen High Limit can not be set less than or equal to the Oxygen Low Limit. **The factory default for Oxygen High Limit is 100%.**

Oxygen Low Limit
The Oxygen Low Alarm Limit range is from 18% to 99%. The Oxygen Low Alarm Limit can not be set equal to or greater than the Oxygen High Limit. **The factory default value for Oxygen Low Limit is 20%.**

### Procedure

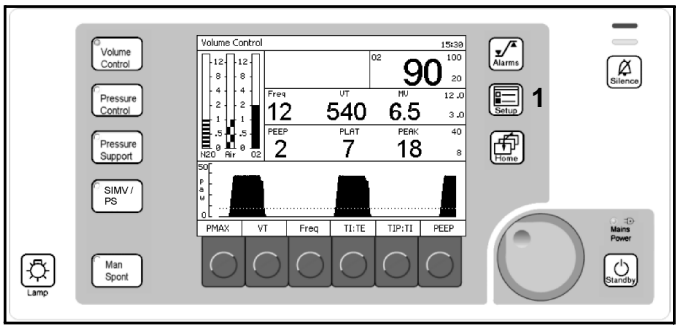
See “Alarms” on page 91 to change the high or low alarm limit.

## Calibrating the Oxygen Sensor

To calibrate the oxygen sensor correctly, make sure it is exposed only to room air during the entire calibration period. The oxygen sensor should be calibrated as part of the daily preoperative setup of the anesthesia equipment.

1. Press the Setup key (**1** in Figure 118).

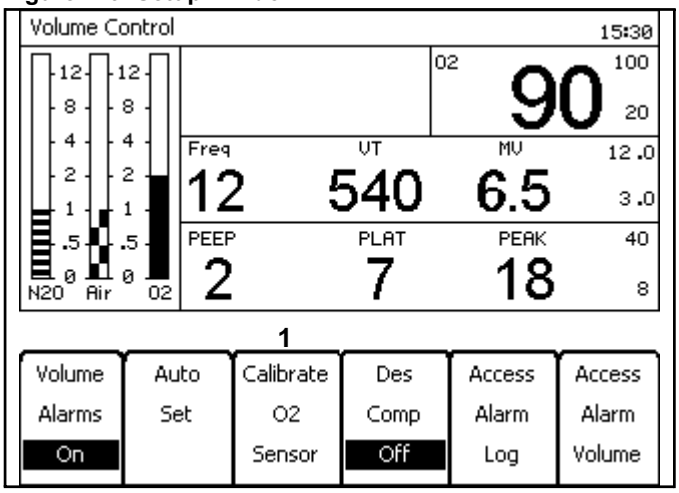
**Figure 118. Ventilation Monitor Screen and System Controls**




The Setup screen appears (Figure 119).

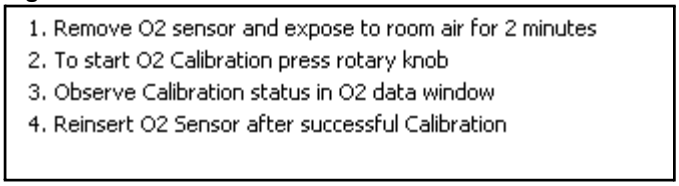
2. Press the soft key under the Calibrate $O_2$ Sensor soft key label (**1** in Figure 119).

**Figure 119. Setup Window**




The Calibrate $O_2$ Sensor Instruction window replaces the Setup screen soft key labels window (Figure 120).

**Figure 120. Calibrate $O_2$ Sensor Instruction Screen**


1. Remove O2 sensor and expose to room air for 2 minutes
2. To start O2 Calibration press rotary knob
3. Observe Calibration status in O2 data window
4. Reinsert O2 Sensor after successful Calibration

After the instructions are followed and the rotary knob is pressed, the present $O_2$ value is replaced by "CAL" (**1** in Figure 121).

Upon successful completion of the calibration, the $O_2$ concentration measurement is restored.

If, at the end of the calibration period, the O2 SENSOR FAIL! Advisory message appears in the Alarm window, the calibration was not successful.

An unsuccessful calibration can be caused by several conditions as described in Table 2 on page 95.

**Figure 121. Calibrate $O_2$ Sensor in Progress Bar**

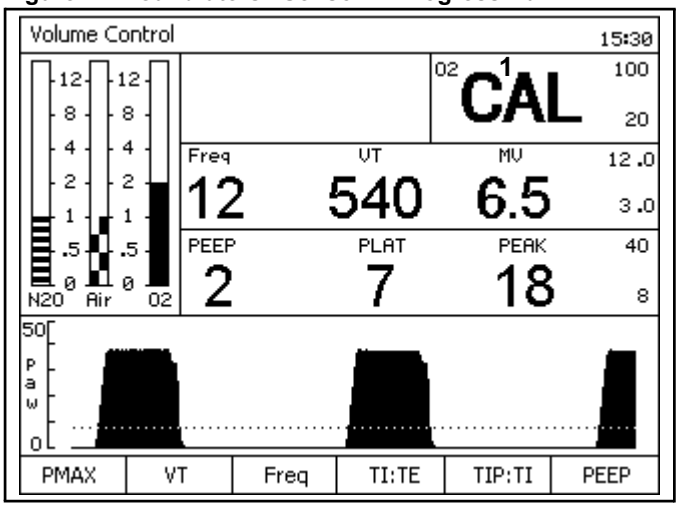


**Table 2. Unsuccessful Calibration – Causes and Solutions**

| Cause | Solution |
|---|---|
| Sensor was exposed to an excessively lean or excessively rich oxygen calibration mixture. | Make sure that the sensor is exposed to room air for the entire calibration period. |
| Sensor was exposed to a constantly changing calibration mixture. | Make sure that the sensor is exposed to room air for the entire calibration period. |
| Sensor did not receive the proper waiting period. | If the sensor capsule was removed from the sensor assembly, a waiting period equal to the time that the capsule spent outside the sensor assembly is necessary prior to calibration. New sensors require a 15-minute waiting period. |
| Sensor is exhausted. | If the oxygen sensor has decayed beyond its useful service life (see the “Specifications” section of the manual), replace the exhausted sensor with a new sensor and allow the proper waiting period. |
| Sensor is disconnected. | When the sensor is disconnected or if there is no cell in the housing, the display area is blank, and the message O2 SENSOR FAIL! appears in the Alarm window. If this happens, ensure that the sensor is correctly assembled and recalibrate the oxygen sensor. |

### Consequences

If the oxygen sensor is improperly calibrated, it can cause inaccurate measurements. When a calibration gas mixture is excessively rich or lean in oxygen, the Fabius Tiro will not complete an attempted calibration; however, if the calibration gas is rich or lean but is within certain limits, the Fabius Tiro will complete the calibration. As a result, when displaying sensor measurements, the Fabius Tiro displays an oxygen percentage either higher or lower than the actual oxygen percentage. Therefore, make sure that the sensor is exposed only to room air during the entire calibration period.

Figure 122 illustrates the relationship between the calibration mixture and the accuracy of oxygen measurement.

**A** = Displayed $O_2$ Percentage

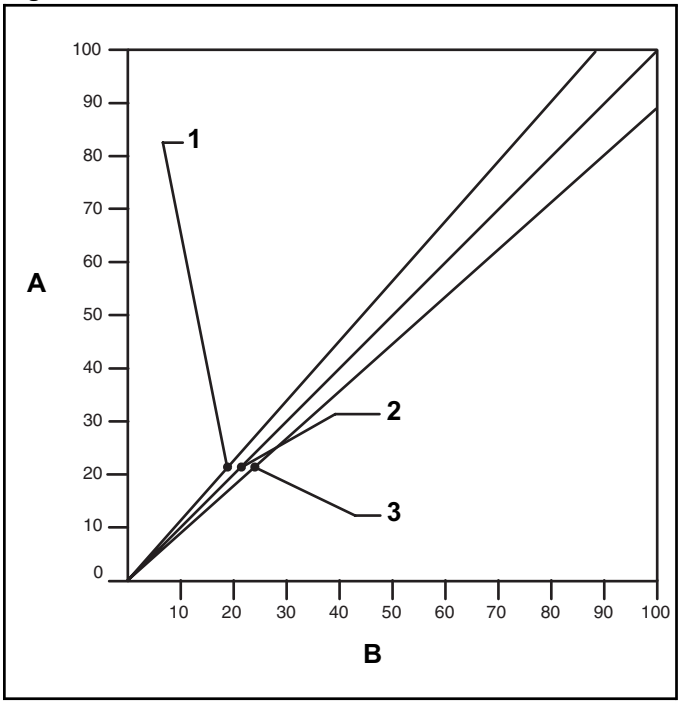
**B** = Actual $O_2$ Percentage

**1** = At calibration, sensor exposed to < 21% $O_2$. Thus, displayed % $O_2$ will be **higher** than actual $O_2$.

**2** = **Correct** calibration of room air (21% $O_2$) for entire calibration period. Displayed % $O_2$ = actual % $O_2$.

**3** = At calibration, sensor exposed to > 21% $O_2$. Thus, displayed % $O_2$ will be **lower** than actual % $O_2$.

**Figure 122. Measurement Error Due to Incorrect Calibration**



## Oxygen Alarm Messages

The following list contains all warning, caution, and advisory alarms associated with oxygen monitoring.

### INSP $O_2$ LOW (Warning)

The Warning message INSP $O_2$ LOW!!! appears in the Alarm window and an alarm sounds if the measured inspiratory oxygen concentration falls below the low alarm limit.

### $O_2$ SUPPLY LOW (Warning)

The Warning message $O_2$ SUPPLY LOW!!! appears in the Alarm window and an alarm sounds if the oxygen supply drops too low to properly pressurize the fresh gas circuit (below about 20 psi (1.4 bar)).

At the onset of this alarm condition, a steady tone is annunciated for seven seconds. This tone can not be silenced. The red LED indicator in the $O_2$ area will flash until the $O_2$ supply is restored.

Under normal operating conditions, the $O_2$ supply channel is pressurized sufficiently to prevent this alarm from occurring. If the $O_2$ supply pressure fails and $O_2$ is not being used by the Fabius Tiro, the circuit will remain pressurized and the $O_2$ SUPPLY LOW alarm will not annunciate immediately. If pressure is reduced in this circuit by the use of $O_2$, $O_2$ flush, etc., the alarm will annunciate when the internal supply pressure drops below 20 psi (1.4 bar), nominal.

### INSP O2 HIGH (Caution)

If the measured inspiratory oxygen concentration exceeds the high alarm limit, the Caution message INSP $O_2$ HIGH!! appears in the Alarm window, and an intermittent audible alarm sounds.

### $O_2$ SENSOR FAIL (Advisory)

The Advisory message $O_2$ SENSOR FAIL! appears in the Alarm window when any of the following instances occur:

- $O_2$ sensor has not been correctly calibrated.
- $O_2$ sensor replaced and/or not calibrated.
- $O_2$ sensor used up.
- $O_2$ sensor disconnected.
- Faulty sensor cable.

### $O_2$ SENSOR CAL DUE (Advisory)

More than 18 hours have passed since the last sensor calibration.

## Oxygen Monitoring Problem Resolution

**Table 3. Oxygen Monitoring Problem Resolution**

| PROBLEM | POSSIBLE CAUSE | REMEDY |
|---|---|---|
| Alarm Message $O_2$ SENSOR FAIL! appears in Alarm window. | Sensor needs calibration (Display area remains blank when a reading is expected.) | Perform proper calibration. Remove sensor assembly from breathing circuit. Make sure sensor is exposed to room air only. Calibrate the sensor. |
| | Hardware malfunction. | Contact DrägerService. |
| | Faulty sensor housing and cable. | Replace housing/cable assembly. |
| | Sensor cord is disconnected. | Insert sensor cord connector into the interface panel. |
| Pressing the Calibrate $O_2$ Sensor soft key does not initiate calibration. | Sensor is disconnected. | Insert sensor cord connector into the interface panel. |
| | Sensor cord is damaged. | Replace housing/cord assembly. |
| Pressing Calibrate $O_2$ Sensor soft key initiates calibration, but Oxygen Monitor window is blank at end of calibration period. | Sensor is exposed to incorrect oxygen concentration. | Expose sensor to room air for 21% calibration. |
| | Sensor exposed to constantly changing calibration mixture. | |
| | Sensor capsule was removed from housing for a prolonged period. | Allow a waiting period equal to duration of capsule removal. |
| | New capsule not given proper waiting period. | Allow 15 minute waiting period. |
| | Exhausted or faulty sensor capsule. | Replace sensor capsule. |

# Respiratory Volume Monitoring

## Respiratory Volume Monitoring Overview

Respiratory volume is measured using thermal anemometry. The flow sensor output is converted into meaningful readings for minute volume, tidal volume, and respiratory rate displays.

**Caution:** Although the Fabius Tiro is designed to minimize the effects of ambient radio-frequency interference, the functioning of the respiratory volume monitor may be adversely affected by the operation of electrosurgical equipment or short wave or microwave diathermy equipment in the vicinity.

**Note:** Sudden, irregular expiratory flow may cause erratic tidal volume and respiratory rate displays. To avoid such erroneous measurements, defer reading the display until a full minute has elapsed after the irregular flow has stopped.

## Respiratory Volume Monitor Display

Information about the patient's respiratory volume is presented in the Respiratory Volume Monitor window in the middle of the monitor display as shown in Figure 123. From left to right, measured values are shown for breathing frequency (**1**), tidal volume (**2**), and minute volume (**3**). At the extreme right, in small type, is the minute volume high alarm limit (**4**) and the minute volume low alarm limit (**5**).

The following numbers in boldface refer to Figure 123.

- **Frequency (Freq) (1)**
  Shows the number of breaths during the previous minute of respiration.
  Readings appear after two breaths.
  The numeric data is displayed in units of Breaths Per Minute (bpm).
  The display range is from 2 bpm to 99 bpm.

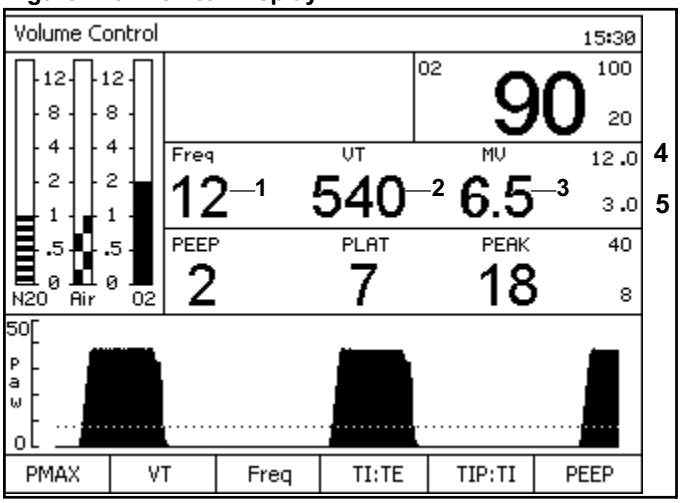
- **Tidal Volume Measurement (VT) (2)**
  Displays the expired volume for each breath.
  The numeric data is displayed in units of milliliters (mL).
  The display range is from 0 mL to 1500 mL.

- **Minute Volume Measurement (MV) (3)**
  Continuously displays the volume of exhaled gas accumulated during the previous minute of respiration.
  The numeric data is displayed in units of liters/minute (L/min).
  The display range is from 0.0 L/min to 99.9 L/min.

- **Minute Volume Alarm High Limit (4)**
  Indicates the volume above which an alarm condition occurs.
  The numeric data is displayed in units of liters/minute (L/min).

- **Minute Volume Alarm Low Limit (5)**
  Indicates the volume below which an alarm condition occurs.
  The numeric data is displayed in units of liters/minute (L/min).

**Figure 123. Monitor Display**



## Respiratory Volume Monitor Controls

The following numbers in boldface refer to Figure 124.

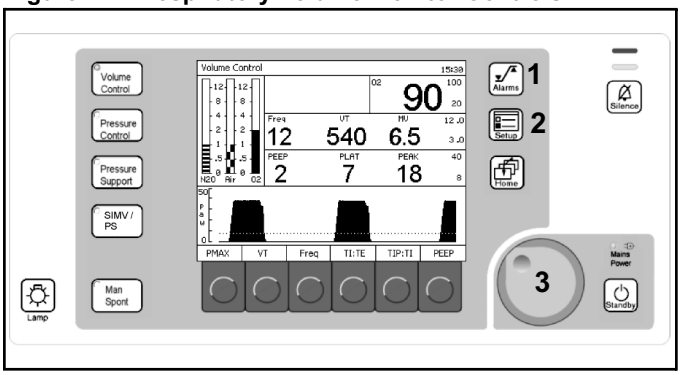
You can use the Alarm Limits key (**1**), the Setup key (**2**), and the rotary knob (**3**) to set the high and low respiratory volume alarm limits and to disable volume alarms.

While the ventilator is on and the volume alarms are enabled, apnoea alarms are generated if the respiratory volume monitor does not sense a valid breath for a specified period (see “APNOEA FLOW (Warning/Caution)” on page 101).

While the ventilator is off and the system is in ManSpont mode, these alarms are generated at 30 seconds (Caution) and 60 seconds (Warning).

The Fabius Tiro's volume alarms are automatically enabled when the ventilator is switched from Standby to a ventilation mode.

**Figure 124. Respiratory Volume Monitor Controls**




## Setting the Minute Volume Alarm Limits

If the minute volume falls below the minute volume low alarm limit or above the minute volume high limit, an alarm condition occurs.

### Minute Volume High Limit

The Minute Volume High Limit range is from 0.1 L/min. to 20.0 L/min.
**Factory default value: 12.0 L/min.**

### Minute Volume Low Limit

The Minute Volume Low Limit range is from 0.0 L/min. to 19.9 L/min.
**Factory default value: 3.0 L/min.**

### Procedure

See “Alarms” on page 91 to change the high and low alarm limit.

See “Setup Window Access” on page 111 to disable/enable volume alarms.

## Respiratory Volume Alarm Messages

The following list contains all warning, caution, and advisory alarms associated with respiratory volume monitoring.

**APNOEA FLOW (Warning/Caution)**

The Fabius Tiro continuously monitors the expiratory flow in the patient breathing system. By processing the expiratory flow pattern, the monitor can determine whether a valid breath has occurred. A valid breath has a tidal volume of 20 mL or greater.

**When the system is in Pressure Control Mode, Volume Control Mode, SIMV/PS Mode, or Pressure Support Mode with Apnoea Ventilation OFF:**

- If 15 seconds pass and a valid breath is not detected (30 seconds in SIMV/PS mode with Freq set below 6), the Caution message APNOEA FLOW!! appears in the Alarm window, and an intermittent audible alarm sounds.
- If an additional 15 seconds pass (30 seconds total) and a valid breath is not detected (an additional 30 seconds (60 seconds total) in SIMV/PS mode with Freq set below 6), the Caution message APNOEA FLOW!! is upgraded to a Warning in the Alarm window, and a continuously repeating audible alarm sounds.

During apneic conditions, the respiratory volume measurements disappear after 30 seconds. When a valid breath is detected, alarm annunciation ceases and a tidal volume measurement appears in the display window.

**When the system is in ManSpont Mode or Pressure Support Mode with Apnoea Ventilation ON**:

- The Caution condition does not occur until 30 seconds have elapsed without a valid breath.
- The Warning condition does not occur until 60 seconds have elapsed without a valid breath.

During apneic conditions, the respiratory volume measurements disappear after 30 seconds. When a valid breath is detected, alarm annunciation ceases and a tidal volume measurement appears in the display window.

**APNOEA VENTILATION**

If two consecutive Apnoea Ventilation breaths occur, the Caution message APNOEA VENTILATION !! appears in the Alarm window.

**EXP PORT LEAKAGE (Caution)**

Expiratory volume during inspiration is greater than 15 mL.

**MINUTE VOLUME HIGH (Caution)**

Whenever the Fabius Tiro measures a minute volume higher than the high minute volume alarm limit, the Caution message MINUTE VOLUME HIGH!! appears in the Alarm window, and an intermittent audible alarm sounds.

**MINUTE VOLUME LOW (Caution)**

Whenever the Fabius Tiro measures a minute volume less than the low minute volume alarm limit, the Caution message MINUTE VOLUME LOW!! appears in the Alarm window, and an intermittent audible alarm sounds.

**FLOW SENSOR CAL DUE (Advisory)**

The FLOW SENSOR CAL DUE! advisory message appears in the Alarm window if it has been longer than 18 hours since the flow sensor has been calibrated, or if the cable has been removed and reconnected.

**FLOW SENSOR FAIL (Advisory)**

The FLOW SENSOR FAIL! advisory message appears in the Alarm window if the sensor cable is not properly connected to the interface panel, or if there is an internal sensor fault.

**VOLUME ALARMS OFF (Advisory)**

Volume alarms disabled by the operator.

## Respiratory Volume Monitoring Problem Resolution

**Table 4. Respiratory Volume Monitoring Problem Resolution**

| PROBLEM | POSSIBLE CAUSE | REMEDY |
|---|---|---|
| Blank display area, FLOW SENSOR FAIL! alarm message in Alarm window | Sensor cable is disconnected. | Reconnect sensor cable to sensor at breathing system. |
| | Sensor fault | Replace sensor assembly. |
| Inaccurate data displayed | Flow sensor signal drift | Calibrate the sensor. |
| | Desflurane compensation setting not consistent with actual agent delivered | Activate or deactivate “Des Comp” as appropriate. |
| | External agent analyzer providing inaccurate data through the communications port. | Check agent analyzer. Check communications cable. Disconnect analyzer from the Fabius Tiro and set “Des Comp” appropriately. |

# Breathing Pressure Monitoring

## Breathing Pressure Monitoring Displays

Information about the patient's breathing pressure is presented in the Breathing Pressure Monitor Window (**1** in Figure 125) and in the Breathing Pressure Trace Window (**2** in Figure 125).

The Breathing Pressure Monitor window contains breathing pressure measurements expressed in units of $cmH_2O$ (mbar, hPa) as well as the pressure high and pressure threshold alarm limits. The measurement units are selected via the Configuration screen (see "Configuration" on page 130).

**Note:** The Fabius Tiro can be configured by DrägerService to display mean pressure (MEAN) instead of plateau pressure (PLAT).

The following numbers in boldface refer to Figure 126.

- **1 – PEEP (Positive End Expiratory Pressure)**
  The breathing pressure at the end of exhalation. The numeric data display range is from 0 to 30.

- **2 – PLAT (Plateau) Breathing Pressure**
  The breathing pressure at the end of inspiration. The numeric data display range is from 0 to 80.

  **2 – MEAN Breathing Pressure**
  The average of all the instantaneous pressure values recorded during each breath. The numeric data display range is from 0 to 50.

- **3 – PEAK Breathing Pressure**
  The highest instantaneous pressure value for each breath. The numeric data display range is from 0 to 80.

- **4 – Pressure High Alarm Limit**

- **5 – Pressure Threshold Alarm Limit**

- **6 – Breathing Pressure Trace Window**

- **7 – Breathing Pressure Threshold Limit Line**

- **8 – Breathing Pressure Minimum and Maximum Vertical Limits Indicator**
  Pressure measurements are displayed in units of $cmH_2O$ and are automatically scaled from 0 to 20, 0 to 50, or 0 to 100 $cmH_2O$.

**Figure 125. Breathing Pressure Monitoring Displays**

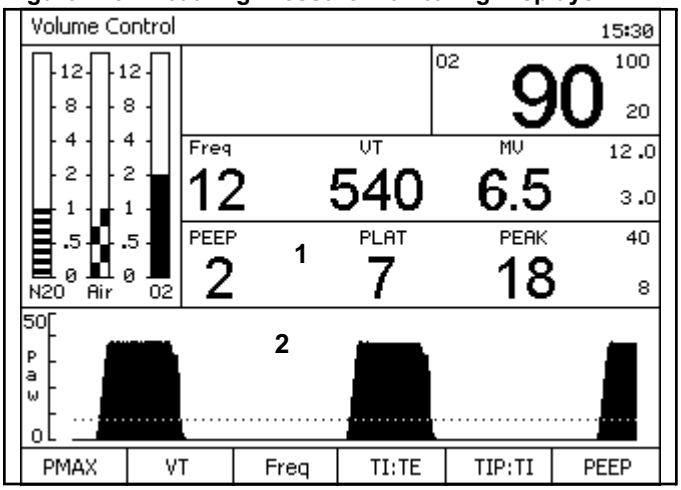
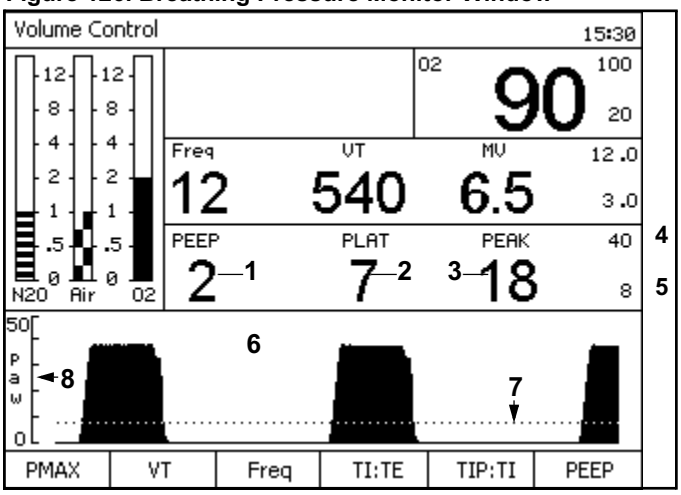



**Figure 126. Breathing Pressure Monitor Window**



## Breathing Pressure Monitor Controls

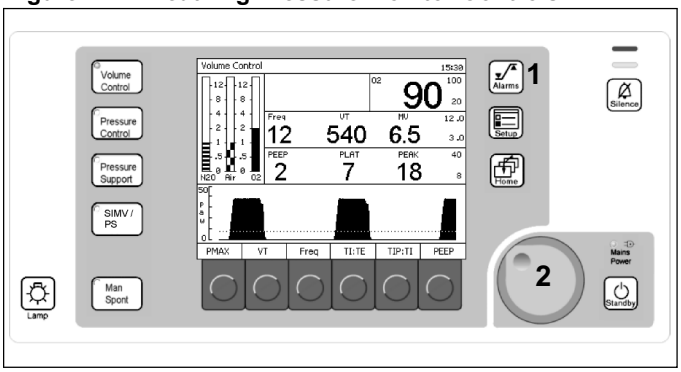
The following numbers in boldface refer to Figure 127.

The Alarm Limits key (**1**) and the rotary knob (**2**) enable you to set breathing pressure alarm limits.

While the ventilator is on, apnoea pressure alarms are generated if the breathing pressure monitor does not sense a valid breath for a specified period of time (see “APNOEA PRESSURE (Warning/Caution)” on page 106).

While the ventilator is off and the system is in ManSpont mode, these alarms are generated at 30 seconds (Caution) and 60 seconds (Warning).

**Figure 127. Breathing Pressure Monitor Controls**




## Setting the Pressure and Threshold Alarm Limits

At power-up and when you press the Restore Default Settings key on the Standby screen, the breathing pressure high and pressure threshold alarm limits are automatically set to their default settings. You can adjust these limits within specified ranges.

### Pressure Threshold Alarm Limit

The Pressure Threshold Limit range is from 5 to 30 $cmH_2O$ (mbar, hPa).
**Factory default value: 8 $cmH_2O$ (mbar, hPa).**

The pressure threshold alarm limit defines the level below which an apneic alarm condition exists. When the patient's breathing pressure falls below the threshold limit for specified period of time (see “APNOEA PRESSURE (Warning/Caution)” on page 106), a message appears in the Alarm window and an audible alarm sounds.

**Note:** The pressure threshold alarm limit should be as close as possible to the sensed plateau pressure without exceeding it, approximately 4 $cmH_2O$ (mbar, hPa) below the plateau pressure.

### Procedure

See “Alarms” on page 91 to change the pressure high alarm limit.

## Breathing Pressure Alarm Messages

The following list contains all warning, caution and advisory alarms associated with breathing pressure monitoring.

**PRES APNOEA ALARM OFF**

The apnoea pressure alarm is disabled (in ManSpont only).

**APNOEA PRESSURE (Warning/Caution)**

**When the system is in Pressure Control Mode, Volume Control Mode, SIMV/PS Mode with Freq set to 6 or above, or Pressure Support Mode with Apnoea Ventilation OFF:**

- If the measured breathing pressure does not cross the pressure threshold alarm limit for more than 15 seconds, the Caution message APNOEA PRESSURE!! appears in the Alarm window and an intermittent audible alarm sounds.
- If the breathing pressure does not cross the pressure threshold for an additional 15 seconds (30 seconds total), the Caution message APNOEA PRESSURE!! is upgraded to a Warning in the Alarm window (APNOEA PRESSURE!!!), and a continuously repeating audible alarm sounds.

**When the system is in ManSpont Mode, SIMV/PS Mode with Freq set below 6, or Pressure Support Mode with Apnoea Ventilation ON:**

- The Caution condition does not occur until 30 seconds have elapsed without a valid breath.
- The Warning condition does not occur until 60 seconds have elapsed without a valid breath.

During apneic conditions, the respiratory pressure measurements disappear after 60 seconds. When a valid breath is detected, alarm annunciation ceases and a tidal volume measurement appears in the display window.

**Note:** When the system is in ManSpont Mode, the APNOEA PRESSURE alarm defaults to OFF.

**CONTINUOUS PRESSURE (Warning)**

If the measured breathing pressure remains above the pressure threshold alarm limit for more than 15 seconds, the breathing pressure display area is cleared, the Warning message CONTINUOUS PRESSURE!!! appears in the Alarm window, and a continuous audible alarm sounds.

When the measured breathing pressure drops below the pressure threshold alarm limit, alarm annunciation ceases.

**AIRWAY PRESSURE HIGH (Warning)**

If the measured breathing pressure exceeds the high pressure limit, the Warning message AIRWAY PRESSURE HIGH!!! appears in the Alarm window and a continuously repeating audible alarm sounds.

This alarm condition is cleared when the measured breathing pressure drops below the high pressure alarm limit. However, the alarm message is extended for 10 seconds to allow for a momentary high pressure condition.

**PRESSURE NEGATIVE (Warning)**

If the measured breathing pressure falls below -5 $cmH_2O$ (mbar, hPa) or mean pressure falls below -2 $cmH_2O$ (mbar, hPa), the Warning message PRESSURE NEGATIVE!!! appears in the Alarm window and a continuously repeating audible alarm sounds.

This alarm condition is cleared when the sensed pressure rises above –5 $cmH_2O$ (mbar, hPa) or above a mean pressure of –2 $cmH_2O$ (mbar, hPa). However, the alarm message is extended for 10 seconds to allow the recognition of a momentary subatmospheric pressure condition.

**EXP PRESSURE HIGH (Caution)**

During Volume or Pressure Ventilation (Caution)
Any time that the monitor measures a PEEP of more than 4 $cmH_2O$ (mbar, hPa) over the PEEP setting, the Caution message EXP PRESSURE HIGH!! appears in the Alarm window and an intermittent audible alarm sounds.

**PEEP HIGH (Advisory)**

During ManSpont Mode (Advisory)
Alarm annunciation occurs when the measured PEEP is greater than 4 $cmH_2O$ (mbar, hPa).

### INSP PRES NOT REACH (Advisory)

Any time that PINSP pressure is not reached in Pressure mode, Pressure Support mode, or SIMV/PS mode, the Advisory message INSP PRES NOT REACH! appears in the Alarm window.

### PRESSURE SENSOR FAIL (Advisory)

If the Fabius Tiro detects a faulty or miscalibrated sensor, the Advisory message PRESSURE SENSOR FAIL! appears in the Alarm window. If this happens, call DrägerService (see “Daily and Preuse Checkout Form” for DrägerService contact information).

### PRESSURE LIMITING (Advisory)

Any time that the monitor detects pressure greater than or equal to the PMAX setting, Advisory message PRESSURE LIMITING! appears in the Alarm window. This advisory can only occur when the ventilator is in Volume Control mode.

### PRES THRESHOLD LOW (Advisory)

The Advisory message PRES THRESHOLD LOW appears in the Alarm window any time the sensed plateau pressure exceeds the threshold pressure alarm limit by more than 6 $cmH_2O$ at threshold pressure alarm limit settings of 5 to 20 $cmH_2O$, or by more than 8 $cmH_2O$ at threshold pressure alarm limit settings of 21 to 29 $cmH_2O$. Setting the threshold pressure alarm limit at 30 $cmH_2O$ disables the PRES THRESHOLD LOW advisory.

## Problem Resolution

**Table 5. Breathing Pressure Monitoring Problem Resolution**

| PROBLEM | POSSIBLE CAUSE | REMEDY |
|---|---|---|
| No pressure readout in display area during ventilation | Pilot line not connected. | Make sure pilot line is properly connected. |
| | Pilot line blocked or kinked. | Make sure that lumen of pilot line is free of obstructions. |
| Erratic readings | Condensation accumulation in pilot line. | Drain and reconnect pilot line. |

# Setup Window (Used During Operation)

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## Overview

This chapter describes the monitoring and ventilation functions available in the Setup window, which can be used in Volume Control, Pressure Control, and ManSpont mode.

The Setup window enables you to

- perform ventilation functions and
- view and change monitoring settings for the current operation.

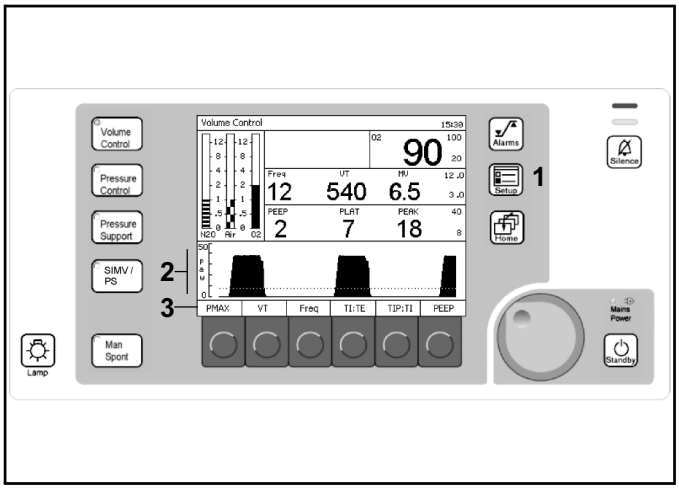
**Note:** To set default monitoring settings to be used at the power-up of each operation, see “Standby Setup Screen” on page 123.

## Setup Window Access

Press the Setup key (**1** in Figure 128) while the ventilator is in Volume Control, Pressure Control, Pressure Support, SIMV/PS, or ManSpont ventilation mode.

The Setup window (**1** in Figure 129) replaces the Waveform area and the soft key labels (**2** and **3** in Figure 128).

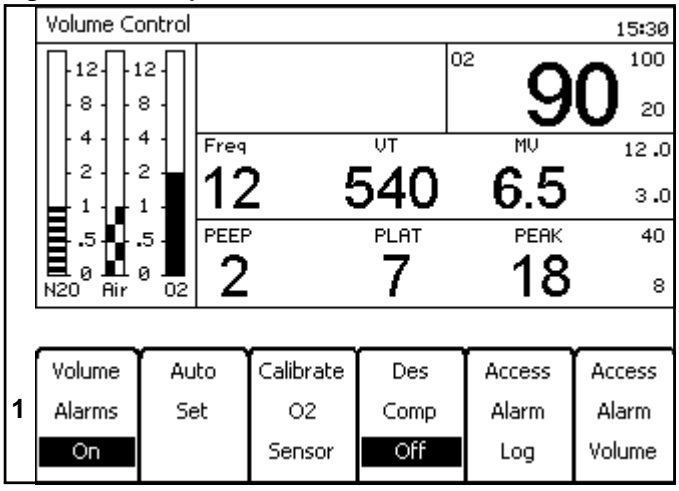
**Figure 128. Ventilation Monitor Screen and System Controls**




The following soft key labels appear in the Setup window:

- Volume Alarms On/Off
- Auto Set
- Calibrate O2 Sensor
- Des Comp On/Off
- Access Alarm Log
- Access Alarm Volume

**Figure 129. Setup Window**



## Volume Alarms On/Off

Press the Volume Alarms On soft key (**1** in Figure 130).

"Volume Alarms On" changes to "Volume Alarms Off," and volume alarms are disabled.

**Note:** The Volume Alarms On/Off soft key label does not appear in ManSpont mode because it is selectable on the ManSpont screen.

## Auto Set

Press the Auto Set soft key (**2** in Figure 130).

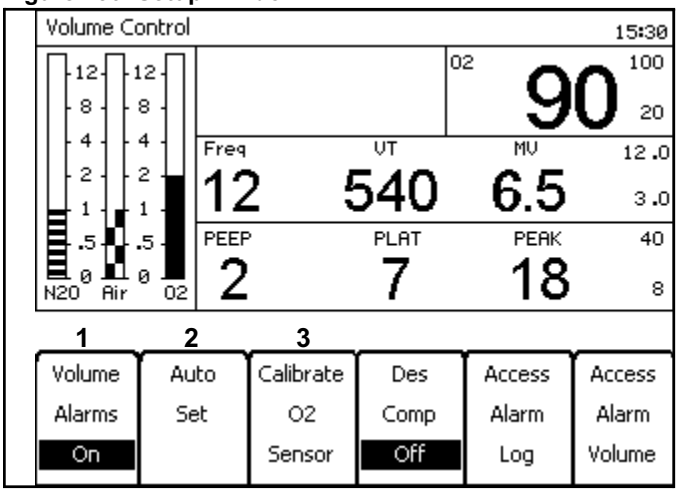
The breathing pressure threshold is set to 4 $cmH_2O$ below the current plateau pressure data value.

**Note:** The threshold setting may not be less than 5 $cmH_2O$ or greater than 30 $cmH_2O$.

**Note:** In the absence of a current plateau pressure data value, pressing the soft key will have no effect.

**Note:** In SIMV/PS mode, the breathing pressure threshold will be set relative to the mandatory ventilation stroke.

**Figure 130. Setup Window**




## Calibrate $O_2$ Sensor

1. Press the Calibrate $O_2$ Sensor soft key (**3** in Figure 130).

   The Calibrate $O_2$ Sensor Instruction window (Figure 131) replaces the Setup window.

2. Follow the instructions and press the rotary knob.

   The present $O_2$ value is replaced by "CAL" (**1** in Figure 132).

   Upon completion of the calibration, the $O_2$ concentration measurement appears.

If the $O_2$ sensor can not be calibrated, replace the $O_2$ capsule in the $O_2$ sensor housing (see "Inserting A New O2 Sensor Capsule" on page 65.

If the $O_2$ sensor still can not be calibrated, call DrägerService (see "Daily and Preuse Checkout Form" for DrägerService contact information).

**Figure 131. Calibrate $O_2$ Sensor Instruction Screen**

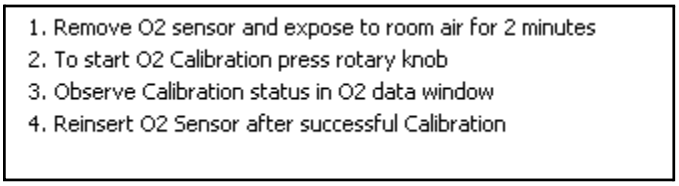
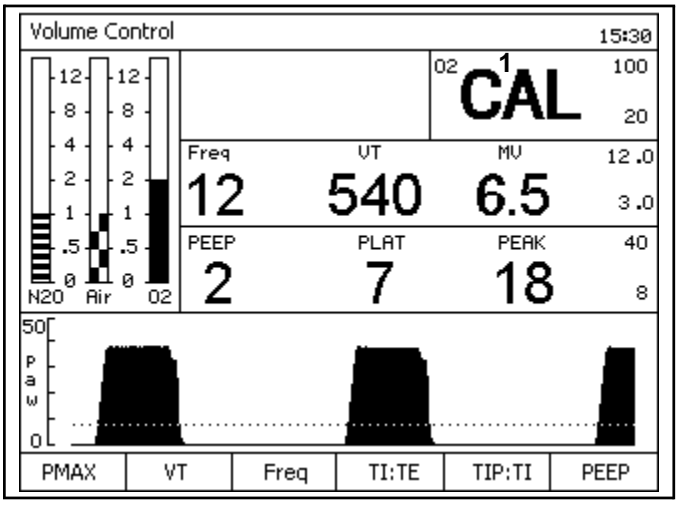

1. Remove O2 sensor and expose to room air for 2 minutes
2. To start O2 Calibration press rotary knob
3. Observe Calibration status in O2 data window
4. Reinsert O2 Sensor after successful Calibration

**Figure 132. Calibrate $O_2$ Sensor in Progress Bar**



## Activate Desflurane Compensation

Press the Des Comp Off soft key (**1** in Figure 133).

When the Des Comp Off soft key is pressed, its soft key label changes from “Des Comp Off” to “Des Comp On” (**1** in Figure 134). “Des on” appears at the top of the Setup window (**2** in Figure 134).

Desflurane compensation is activated.

The Desflurane compensation state will not change when you restore site defaults or run system diagnostics.

**Note:** Desflurane has characteristics that affect the sensitivity of the Fabius Tiro flow sensor. To help assure that the volume measurements from the monitor are accurate, activate Desflurane compensation when Desflurane is used in the breathing circuit. The Fabius Tiro will automatically compensate for the change in flow measurement characteristics caused by the use of Desflurane.

**Caution:** Ensure that Desflurane compensation is only activated whenever Desflurane is used. Failure to activate when Desflurane is used will affect measured volume accuracy. Activating when Desflurane is not used will affect measured volume accuracy.

**Caution:** The Fabius Tiro will automatically compensate for Desflurane when agent concentration data is available through communication with an external agent analyzer. Inaccurate data from the analyzer may affect measured volume accuracy.

**Note:** If Desflurane concentration data is communicated to the Fabius Tiro by an external agent analyzer, the Fabius Tiro will automatically perform the corresponding flow compensation. In this case, the communicated data always overrides the functionality of the Desflurane compensation soft key.

**Figure 133. Setup Desflurane Compensation Off**

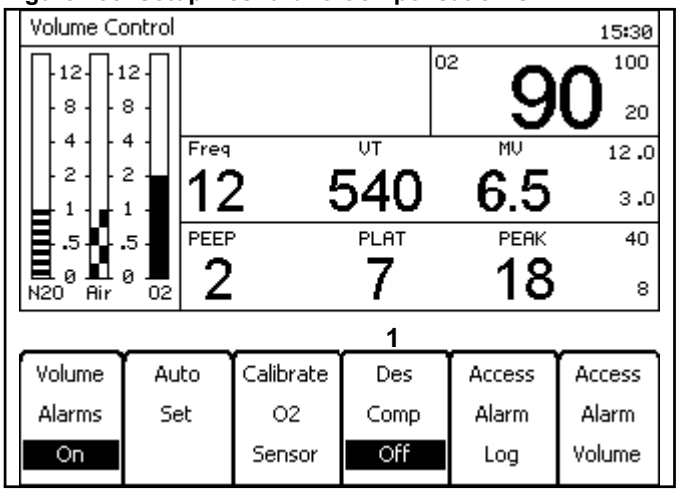
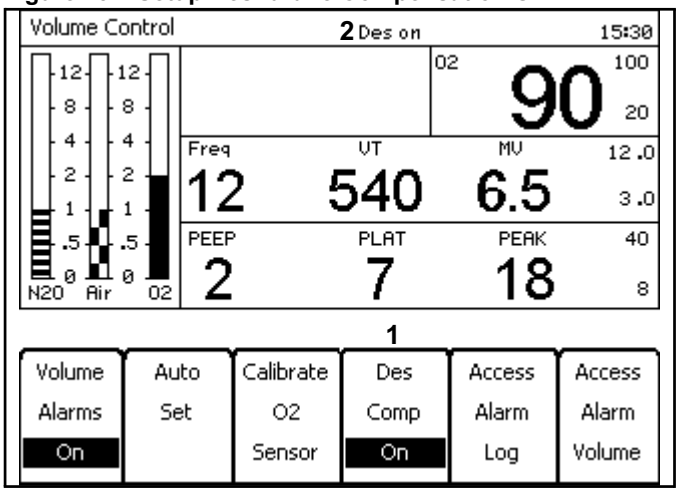



**Figure 134. Setup Desflurane Compensation On**



## Automatic Desflurane Compensation

If Desflurane concentration data is communicated to the Fabius Tiro by an external agent analyzer, the following occurs:

- "Des auto" appears at the top of the Setup window (**1** in Figure 135),
- the Des Comp soft key label (**2** in Figure 135) is removed,
- and the Fabius Tiro will automatically perform the corresponding flow sensor compensation.

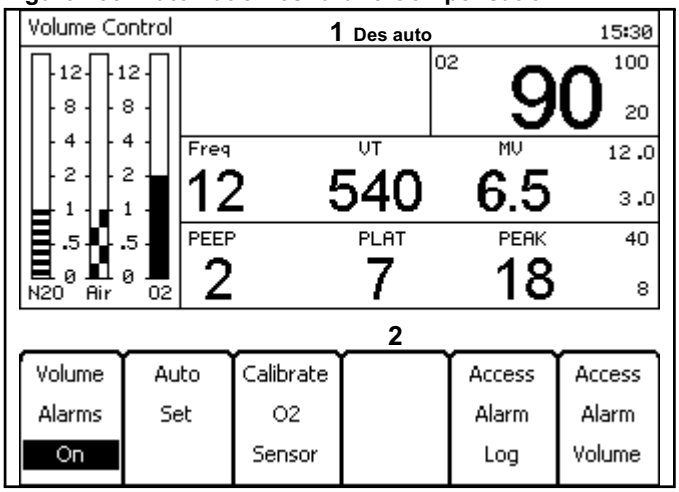
Automatic Desflurane compensation always overrides the functionality of the Desflurane compensation soft key.

If communication is disconnected or lost between the Fabius Tiro and an external agent analyzer while Desflurane is in use,

- the “Des auto” label disappears from the top of the Setup window, and
- the Des Comp soft key label reappears as “Des Comp Off”.

To maintain Desflurane compensation, manually activate Desflurane compensation to ensure accurate volume measurements.

**Figure 135. Automatic Desflurane Compensation**




## Access Alarm Log

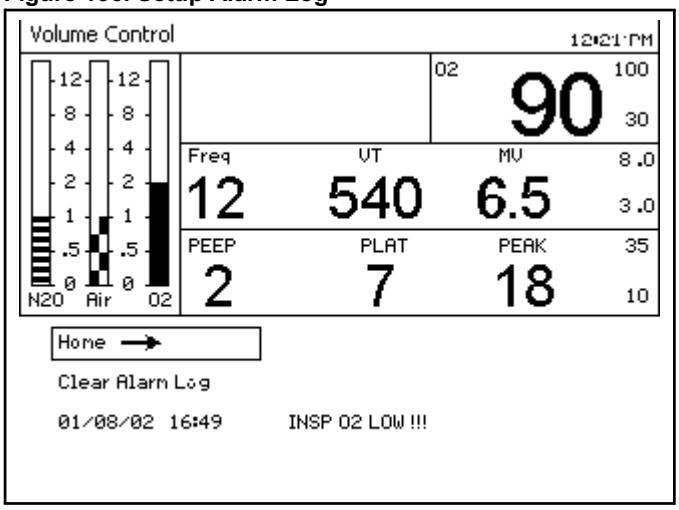
Press the Access Alarm Log soft key.

The alarm log (Figure 136) replaces the Setup window.

Turn the rotary knob to scroll down the list of alarm messages.

**Note:** If “Clear Alarm Log” is selected and confirmed, all alarm messages in the Alarm Log are deleted.

**Figure 136. Setup Alarm Log**



## Access Alarm Volume

1. Press the Access Alarm Volume soft key.

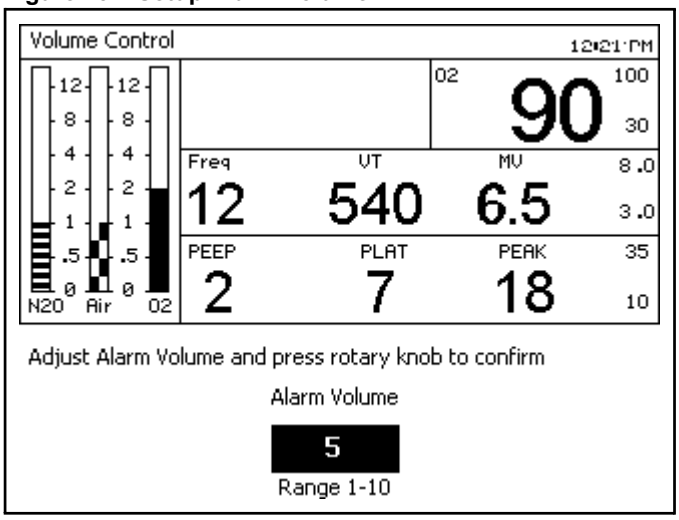
   The Alarm Volume Setting window (Figure 137) replaces the Setup window.

2. Select and confirm a new alarm volume value.

   The new alarm volume value is saved and the Access Alarm Volume Setting window disappears.

**Note:** The value “1” is the minimum and the value of “10” is the maximum.

**Figure 137. Setup Alarm Volume**




## Window Deactivation

Once the Setup window is activated, if no rotary knob activity occurs within 15 seconds, the Setup window is deactivated and the Waveform window is activated. Another way to deactivate the Setup window and activate the Waveform window is to press the Home key.

# Standby Mode Functions

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## Overview

This chapter describes the functions that are made available in Standby mode.

## Standby Screen

### Access

1. Press the Standby key.

   The Standby Confirmation Message and Gas Flow Control Valve Shut Off Message window (**1** in Figure 138) replaces the Waveform window.

   The LED associated with the Standby key starts blinking. It remains blinking until Standby is confirmed by pressing the rotary knob.

   **Note:** If confirmation does not occur within 15 seconds, the Standby Confirmation Message and Gas Flow Control Valve Shut Off Message window are deactivated and the Waveform window is activated. The Ventilator will not be switched to Standby mode.

2. Confirm.

   The Standby screen (Figure 139) replaces the previous screen.

   After the Standby status is confirmed,

   - The Standby key's LED is switched from blinking to constantly on, and the ventilator is switched to Standby mode.
   - If fresh gas flow is detected, then the flows were not shut off before activating Standby mode and the "Gas still flowing!" alarm message will appear in the alarm window (Figure 139). Once all gas flow control valves are shut off, the flow detection alarm message disappears (Figure 140).

**Figure 138. Standby Confirmation Message and Gas Flow Control Valve Shut Off Message Window**

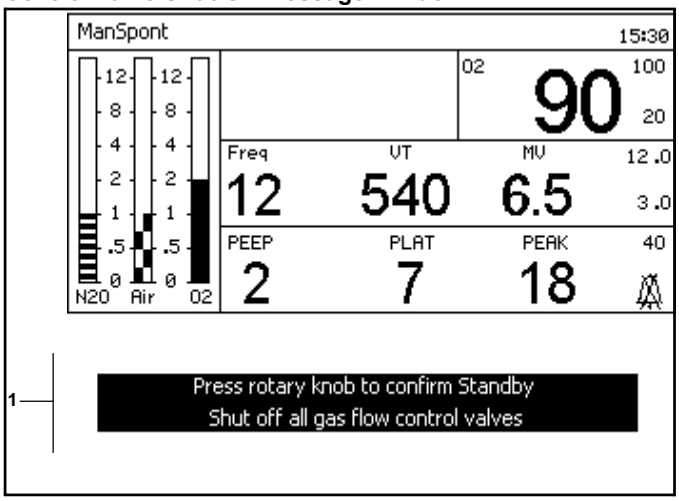



**Figure 139. Standby Screen**

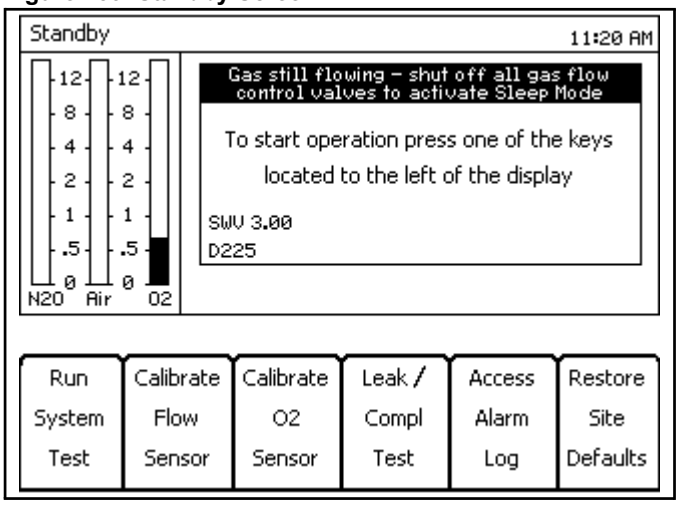
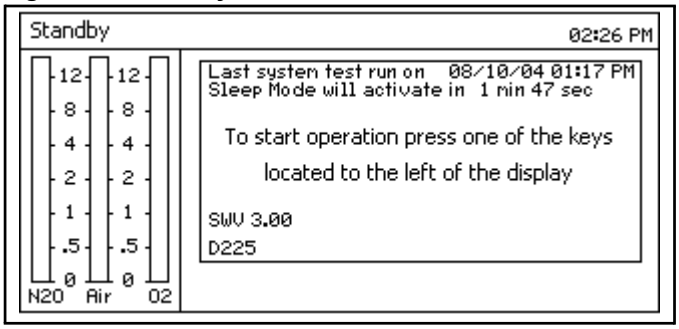



**Figure 140. Standby Screen**


Standby
02:26 PM
Last system test run on 08/10/04 01:17 PM
Sleep Mode will activate in 1 min 47 sec
To start operation press one of the keys located to the left of the display
SWV 3.00
D225
N20
Air
02

## Sleep Mode

If 2.5 minutes elapse in Standby mode with no user input, SLEEP mode is activated (Figure 141). The Ventilator monitor screen is replaced by the screen saver. The Screen Saver displays a message that provides instructions on how to activate Standby mode.

**Figure 141. Sleep Mode Screen**

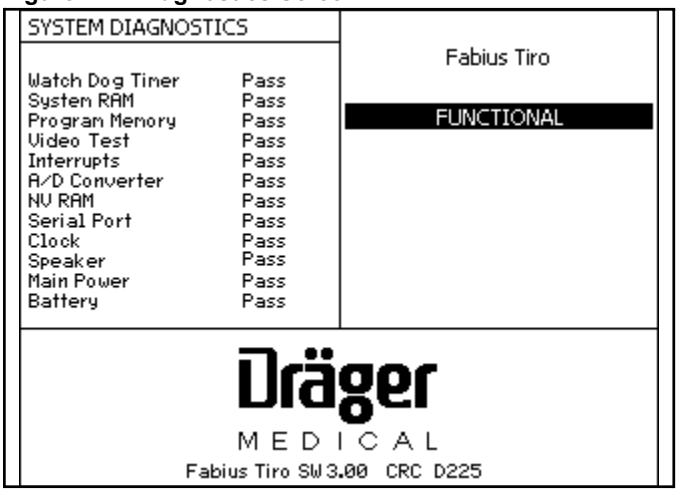
## Run System Test

Press the Run System Test soft key.

The system diagnostics is performed (Figure 142).

After successful completion, the system switches to the Standby screen.

**Figure 142. Diagnostics Screen**

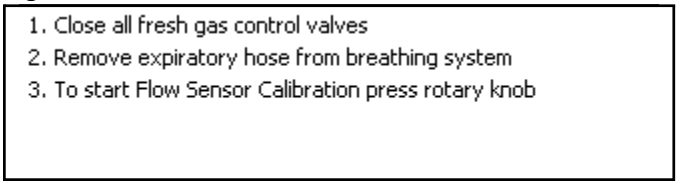



## Calibrate Flow Sensor

1. Press the Calibrate Flow Sensor soft key.

   The Calibrate Flow Sensor Instruction window replaces the Standby screen soft key labels (Figure 143).

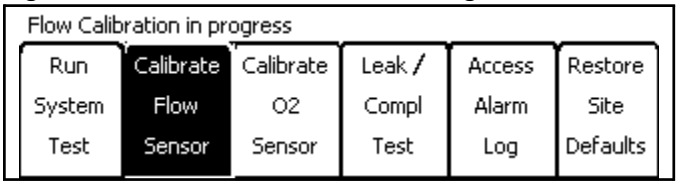
**Figure 143. Calibrate Flow Sensor Instruction Screen**


1. Close all fresh gas control valves
2. Remove expiratory hose from breathing system
3. To start Flow Sensor Calibration press rotary knob

2. Follow the instructions.

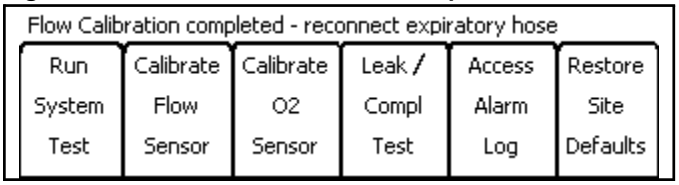
   The Calibrate Flow Sensor in Progress bar replaces the instruction window (Figure 144).

**Figure 144. Calibrate Flow Sensor in Progress Bar**




3. Upon completion of the calibration, the “Flow Sensor Calibration completed” message (Figure 145) or the “Flow Sensor Calibration FAILED” message (Figure 146 on page 120) appears.

**Figure 145. Calibrate Flow Sensor Completed Bar**

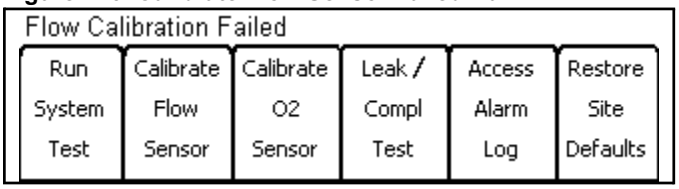



### Flow Sensor Calibration Failed – Troubleshooting

If the Flow sensor can not be calibrated, retry the calibration.

If the Flow sensor still can not be calibrated, call DrägerService (see “Daily and Preuse Checkout Form” for DrägerService contact information).

**Figure 146. Calibrate Flow Sensor Failed Bar**



## Calibrate $O_2$ Sensor

1. Press the Calibrate $O_2$ Sensor soft key.

   The Calibrate $O_2$ Sensor Instruction window replaces the Standby screen soft keys (Figure 147).

2. Follow the instructions.

   The Calibrate $O_2$ Sensor in Progress bar replaces the instruction window (Figure 148).

3. Upon completion of the calibration, the "$O_2$ Sensor Calibration completed" message (Figure 149) or the "$O_2$ Sensor Calibration FAILED" message (Figure 150) appears.

### $O_2$ Sensor Calibration Failed - Troubleshooting

If the $O_2$ sensor can not be calibrated, replace the $O_2$ capsule in the $O_2$ sensor housing (see "Inserting A New O2 Sensor Capsule" on page 65).

If the $O_2$ sensor still can not be calibrated, call DrägerService (see "Daily and Preuse Checkout Form" for DrägerService contact information).

**Figure 147. Calibrate $O_2$ Sensor Instruction Screen**

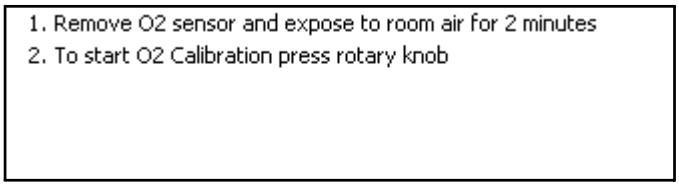



**Figure 148. Calibrate $O_2$ Sensor in Progress Bar**

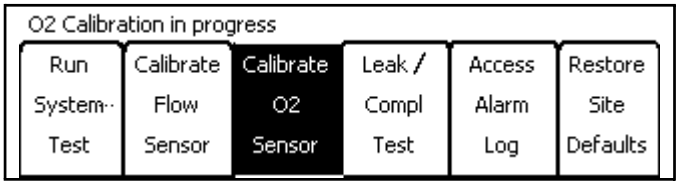



**Figure 149. Calibrate $O_2$ Sensor Completed Bar**

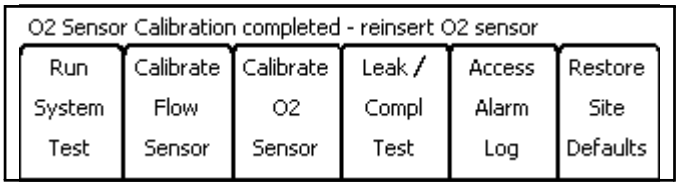
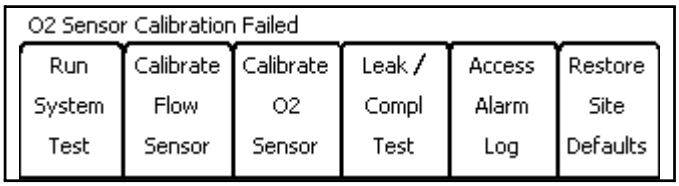



**Figure 150. Calibrate $O_2$ Sensor FAILED Bar**



## Leak / Compliance Test

1. Press the Leak / Compl Test soft key.

   The Leak / Compl Test Ventilator Preparation message replaces the Standby screen (Figure 151), followed by the Leak / Compl Test Instruction screen (Figure 152).

2. Follow the instructions on the Leak / Compl Test Instruction screen.

   Upon completion of the instructions, the Leak / Compl Test Results screen appears (Figure 153 on page 122).

**Figure 151. Leak / Compliance Test Vent Prep Message**

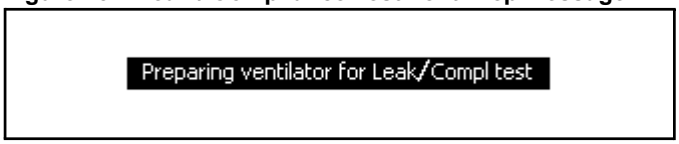



**Figure 152. Leak / Compliance Test Instruction Screen**

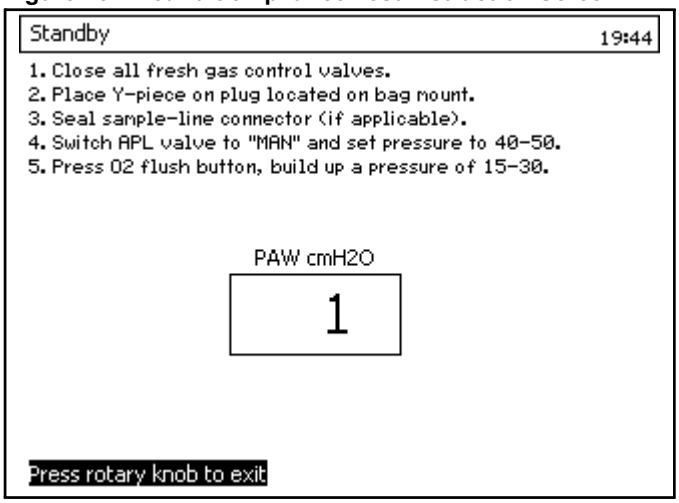
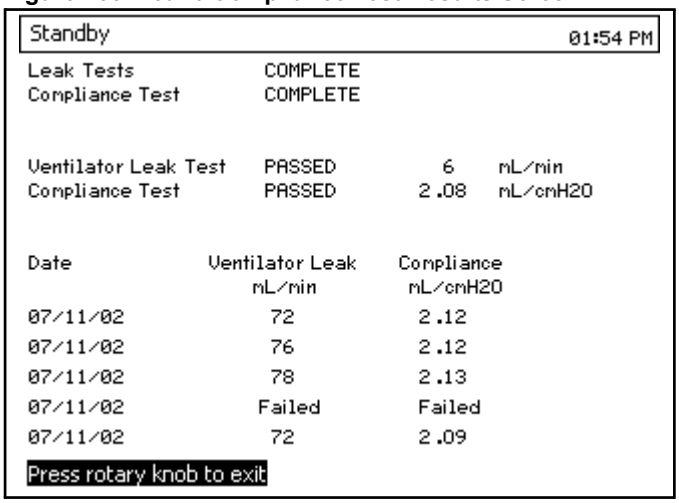

Standby
19:44
1. Close all fresh gas control valves.
2. Place Y-piece on plug located on bag mount.
3. Seal sample-line connector (if applicable).
4. Switch APL valve to "MAN" and set pressure to 40-50.
5. Press O2 flush button, build up a pressure of 15-30.
PAW cmH2O
1
Press rotary knob to exit

**Figure 153. Leak / Compliance Test Results Screen**



## Access Alarm Log

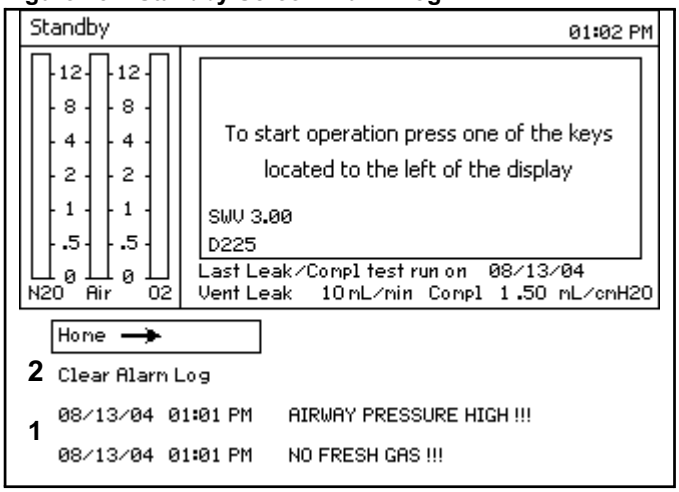
1. Press the Access Alarm Log soft key (**1** in Figure 155).

   The Alarm Log appears (**1** in Figure 154).

2. Turn the rotary knob to scroll through the Alarm Log.

When the “Clear Alarm Log” (**2** in Figure 154) is selected and confirmed, all alarms in the Alarm Log are deleted.

**Figure 154. Standby Screen Alarm Log**

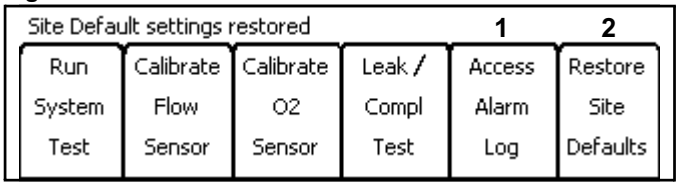



## Restore Site Defaults

Press the Restore Site Defaults soft key (**2** in Figure 155). The pre-defined site default settings are restored, and the “Default settings restored” message appears (Figure 155).

Site default settings are set in the Standby Setup screen.

**Figure 155. Site Defaults Restored Bar**



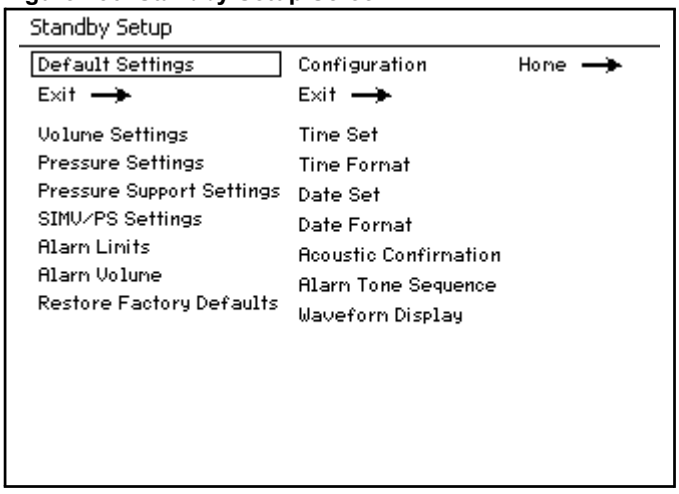

# Standby Setup Screen

In Standby mode, press the Setup key.

The Standby Setup screen (Figure 156) replaces the Standby Screen.

The cursor, which appears over “Default Settings”, enables you to select “Default Settings” or “Configuration”.

**Figure 156. Standby Setup Screen**



## Default Settings

Select and confirm “Default Settings”.

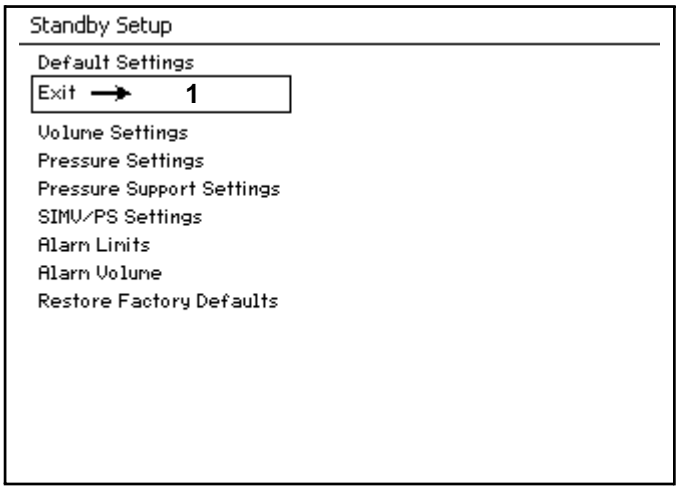
The Default Settings column is selected (Figure 157).

If the return arrow (**1** in Figure 157) is selected and confirmed, the Default Settings column is de-selected and “Default Settings” is selected (Figure 156).

The Default Settings Items are:

- Volume Settings
- Pressure Settings
- Pressure Support Settings
- SIMV/PS settings
- Alarm Limits
- Alarm Volume
- Restore Factory Defaults

**Figure 157. Standby Setup Screen Default Settings Selected**

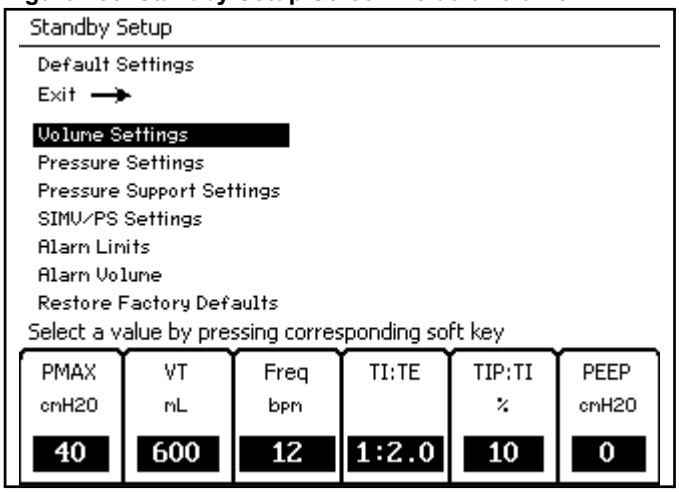


### Volume Settings (IPPV)

1. Select and confirm “Volume settings”.

   The Default Volume Settings window appears along the bottom of the Standby Setup screen (Figure 158).

**Figure 158. Standby Setup Screen Default Volume**




2. Press a soft key (ex., PMAX in Figure 159).

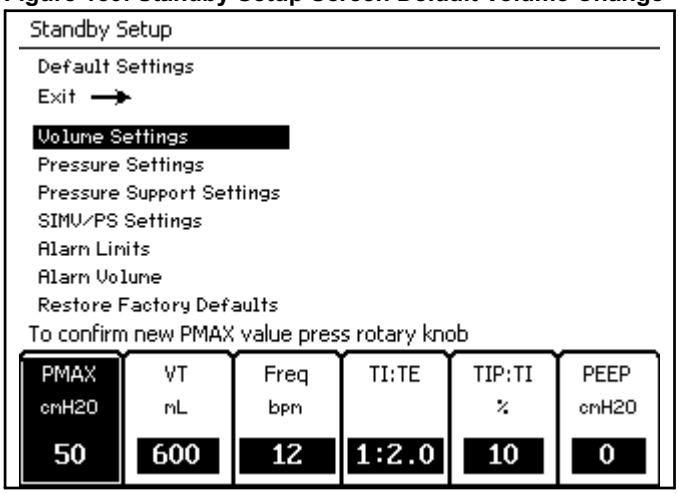
   The cursor appears over the setting for the selected soft key.

3. Select and confirm a new setting value (ex., in Figure 159, the setting value was changed from 40 to 50).

   The Standby Setup screen instructs you to confirm the new default setting (Figure 160).

4. Repeat steps 2 and 3 for setting other parameter values.

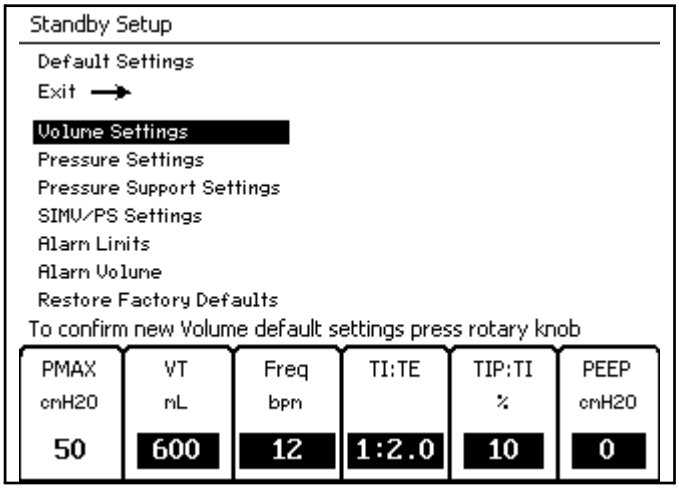
**Figure 159. Standby Setup Screen Default Volume Change**




5. Confirm the new default setting.

   The Default Volume Ventilator Settings window disappears, and the cursor appears over the return arrow.

**Figure 160. Standby Setup Screen Default Volume Change Saved**




### Pressure, Pressure Support, or SIMV/PS Settings

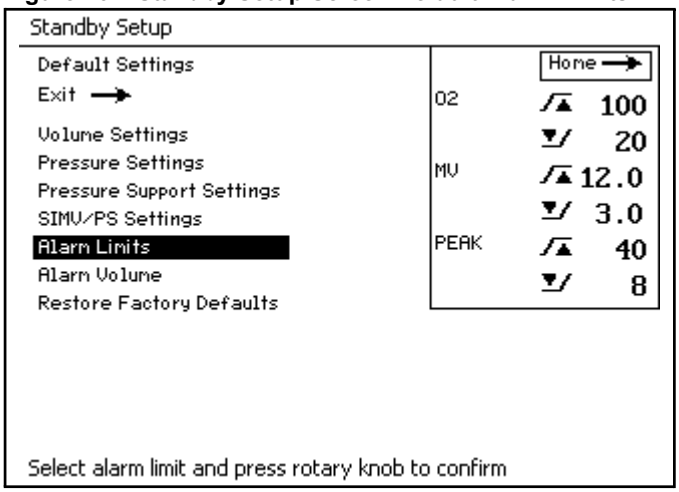
Use the process example in “Volume Settings (IPPV)” and change the parameters associated with each ventilator mode.

### Alarm Limits

1. Select and confirm “Alarm Limits”.

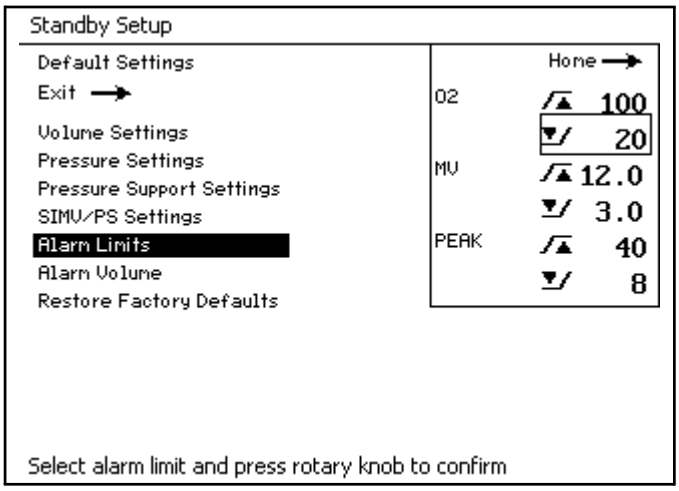
   The Default Alarm Limits window appears (Figure 161).

**Figure 161. Standby Setup Screen Default Alarm Limits**




2. Select and confirm the desired alarm limit (Figure 162).

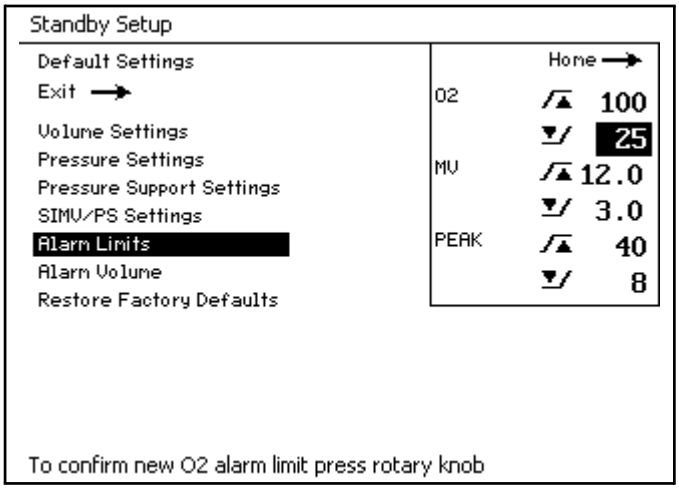
**Figure 162. Standby Setup Screen Default Alarm Limits Select**




3. Select a new setting value (ex., in Figure 163, the setting value was changed from 20 to 25).
4. Confirm the new setting value.

   The new setting is saved and the cursor appears over the return arrow.
5. Repeat steps 2 through 4 for setting other setting values.

**Figure 163. Standby Setup Screen Default Alarm Limits Confirm**



### Setting Alarm Limit Defaults

When the anesthesia machine is started, it uses the default alarm limit values that were established the last time the machine was configured. These values can be viewed and changed in the Alarm Limit window.

The Alarm Limit window is deactivated if the rotary knob is not used within 15 seconds, if the Alarm Limit key is pressed again, or if any other key is pressed.

### Alarm Variables

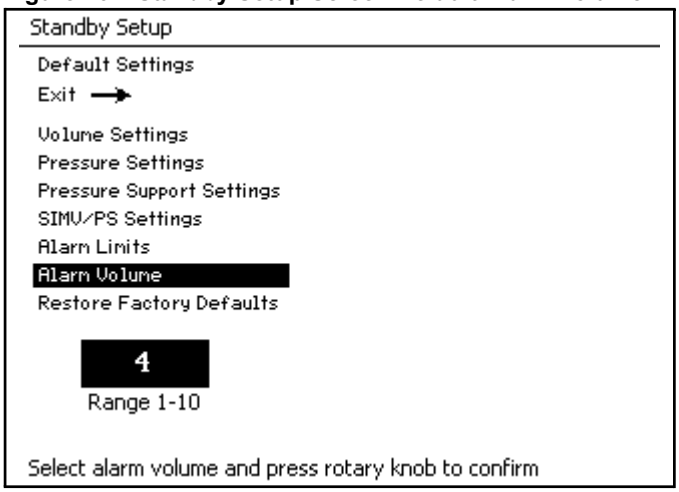
- **Oxygen High Limit** – The Oxygen High Alarm Limit range is from 19% to 100%. It is not possible to set the Oxygen High Limit setting to less than or equal to the Oxygen Low Limit. **The factory default value for Oxygen High Limit is 100%.**
- **Oxygen Low Limit** – The Oxygen Low Alarm Limit range is from 18% to 99%. It is not possible to set the Oxygen Low Limit setting to equal to or greater than the Oxygen High Limit. **The factory default value for Oxygen Low Limit is 20%.**
- **Minute Volume High Limit** – The Minute Volume High Limit range is from 0.1 L/min to 20.0 L/min. **The factory default value is 12.0 L/min.**
- **Minute Volume Low Limit** – The Minute Volume Low Limit range is from 0.0 L/min to 19.9 L/min. **The factory default value is 3.0 L/min.**
- **Pressure High Limit** – The Pressure High Limit range is from 10 to 70 $cmH_2O$ (mbar, hPa). **The factory default value is 40 $cmH_2O$ (mbar, hPa).**
- **Apnoea Pressure Threshold** – The Apnoea Pressure Threshold Limit range is from 5 to 30 $cmH_2O$ (mbar, hPa). **The factory default value is 8 $cmH_2O$ (mbar, hPa).**

### Alarm Volume

1. Select and confirm “Alarm Volume”.

   The Default Alarm Volume Setting window appears next to “Alarm Volume” (Figure 164).

**Figure 164. Standby Setup Screen Default Alarm Volume**

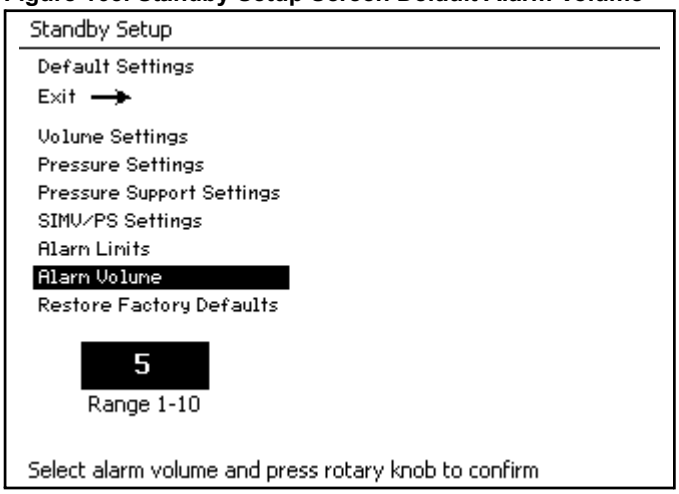



2. Select and confirm a new alarm volume value (ex., in Figure 165, the value is changed from “4” to “5”).

   The new alarm volume value is saved and the Default Alarm Volume Setting window disappears.

**Note:** The value “1” is the minimum and the value of “10” is the maximum.

**Figure 165. Standby Setup Screen Default Alarm Volume**



### Restore Factory Defaults

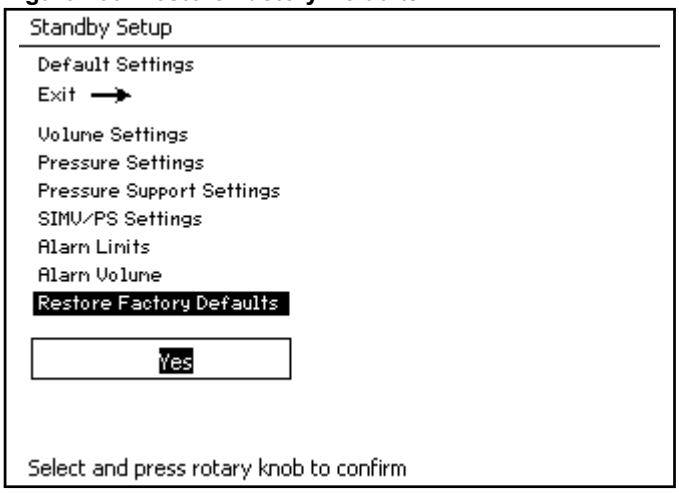
1. Select and confirm “Restore Factory Defaults”.

   The Restore Factory Defaults Setting window appears next to “Restore Factory Defaults” (Figure 166).

2. Select and confirm “Yes” or “No”.

   When “Yes” is selected and confirmed, the factory defaults are restored and replace the Default Settings.

**Figure 166. Restore Factory Defaults**




**The factory default settings:**

Volume Control

- PMAX = 40
- VT = 600
- Freq = 12
- TI:TE = 1:2.0
- TIP:TI = 10
- PEEP = 0

Pressure Control

- PINSP = 15
- Freq = 12
- TI:TE = 1:2.0
- Insp Flow = 30
- PEEP = 0

Pressure Support

- Δ PPS = 10
- Freq Min = 3
- Trigger = 2
- Insp Flow = 30
- PEEP = 0

SIMV/PS

- PMAX = 40
- VT = 600
- Freq = 12
- Δ PPS = 10
- PEEP = 0
- Trigger = 2
- Insp Flow = 30
- Ti = 1.7
- TIP:TI = 10

Alarm Default Settings for $O_2$

- High = 100
- Low = 20

Alarm Default Settings for MV

- High = 12.0
- Low = 3.0

Alarm Default Settings for Pressure

- High = 40
- Threshold = 8

Alarm Audio Volume = 5

## Configuration

Select and confirm “Configuration”.

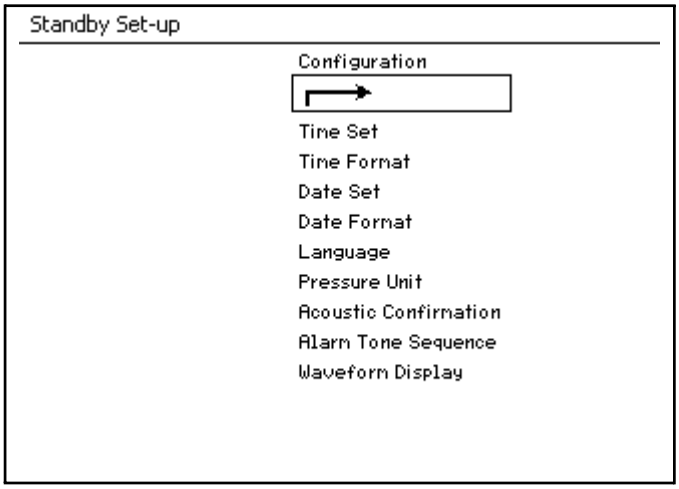
The Configuration column is selected (Figure 167).

If the return arrow is selected and confirmed, the Configuration column is de-selected and “Configuration” is selected.

The Configuration Items are:

- Time Set
- Time Format
- Date Set
- Date Format
- Language
- Pressure Units
- Acoustic Confirmation
- Alarm Tone Sequence
- Waveform Display

**Figure 167. Standby Setup Screen Configuration Settings Selected**

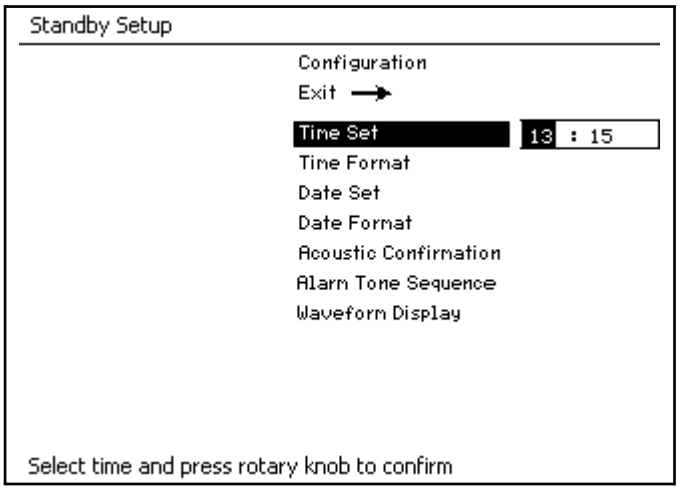


### Time Set

1. Select and confirm “Time Set”.

   The Time Set window appears to the right of “Time Set” and the cursor appears over the hour field (Figure 168).

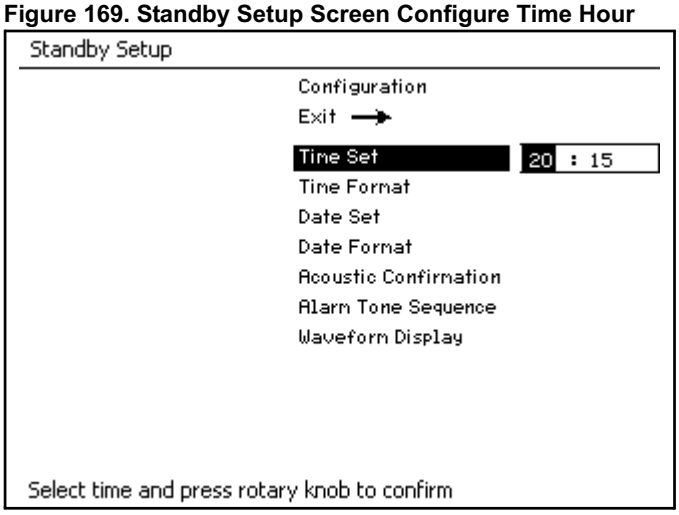
**Figure 168. Standby Setup Screen Configure Time Hour Select**




2. Select and confirm a new hour time value (ex., in Figure 169, the value is changed from “13” to “20”).

   The cursor moves over the minute field (Figure 170).

**Figure 169. Standby Setup Screen Configure Time Hour**

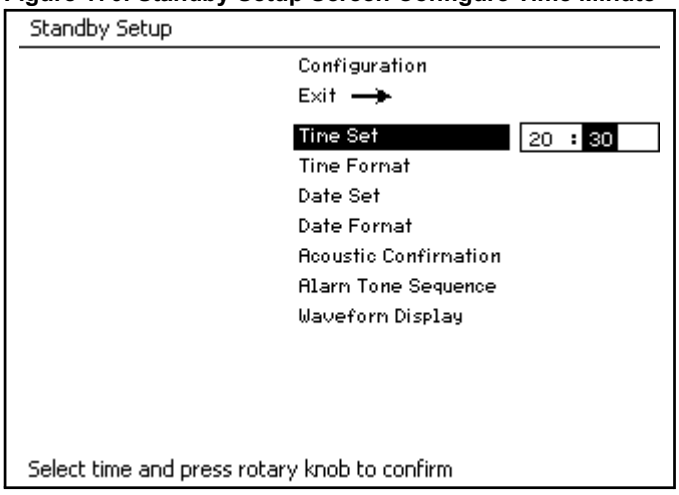



3. Select and confirm a new minute time value (ex., in Figure 170, the value is changed from “15” to “30”).

   The new time values are saved, the Time Set window disappears, and the cursor in the Configuration column appears over “Time Set”.

**Note:** This three-step process also applies to “Date Set” on page 132.

**Figure 170. Standby Setup Screen Configure Time Minute**

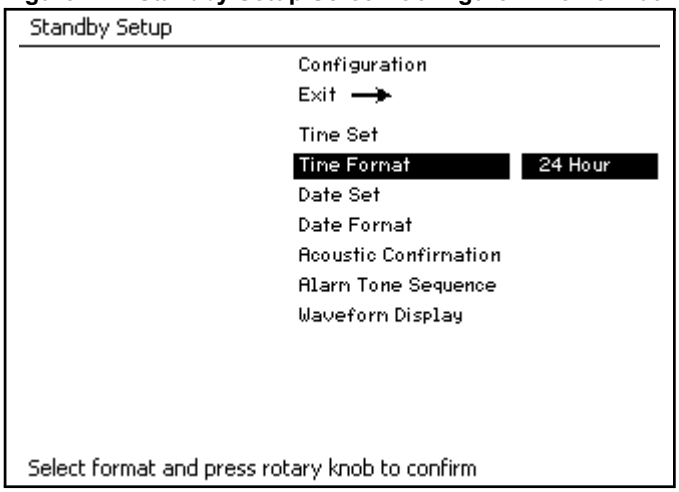


### Time Format

1. Select and confirm “Time Format”.

   The Time Format window appears to the right of “Time Format” and the cursor appears over the default time format value (Figure 171).

**Figure 171. Standby Setup Screen Configure Time Format**



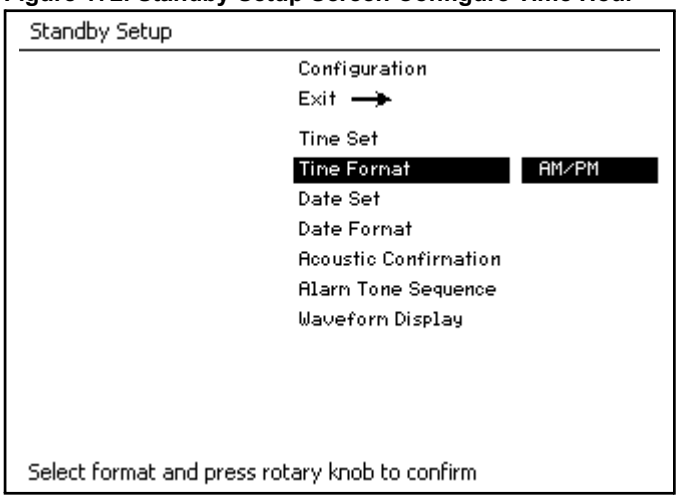

2. Select and confirm a new time format value (ex., in Figure 172, the value is changed from “24:00 Hour” to “AM/PM”).

   The new format value is saved, the Time Format window disappears, and the cursor in the Configuration column appears over “Time Format”.

The values that can be selected are “24 Hour” or “AM/PM”.

**Note:** This two-step process applies to all other items in the Configuration column except for “Time Set” and “Date Set”.

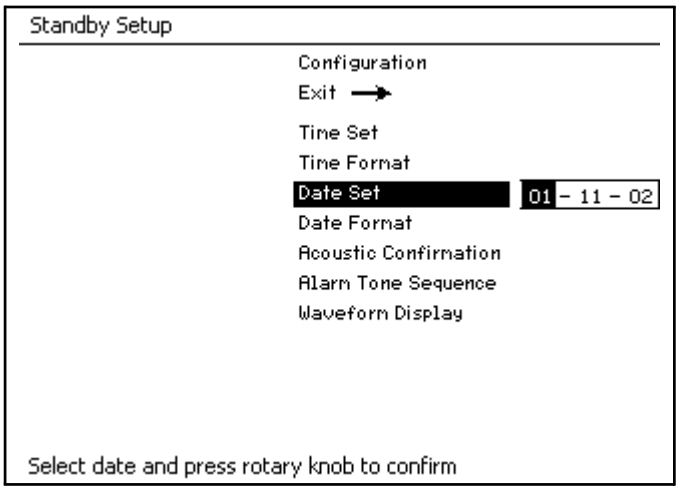
**Figure 172. Standby Setup Screen Configure Time Hour**




### Date Set

The values that can be selected are numerical values applicable to day, month, and two-digit year.

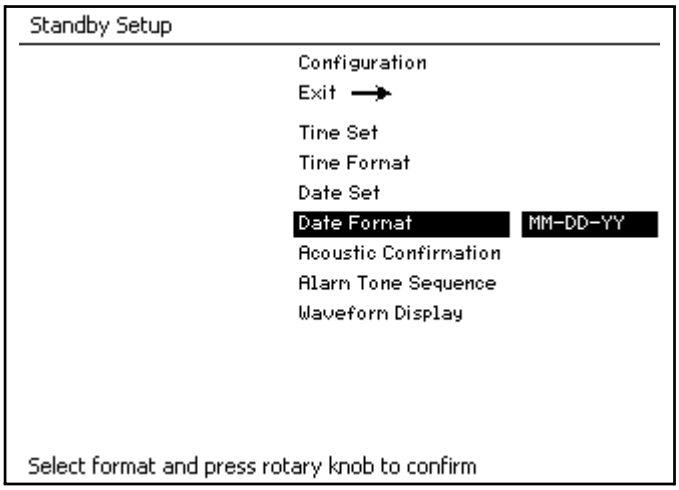
**Figure 173. Standby Setup Screen Configure Date Set Select**



### Date Format

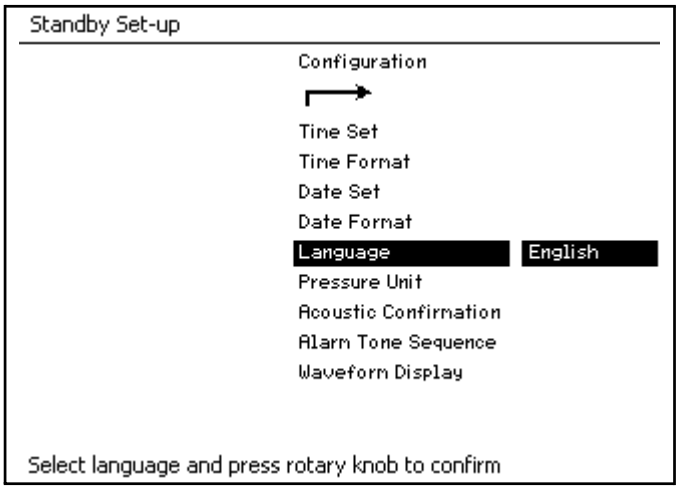
The values that can be selected are “MM-DD-YY” or “DD-MM-YY”.

**Figure 174. Standby Setup Screen Configure Date Format Select**




### Language

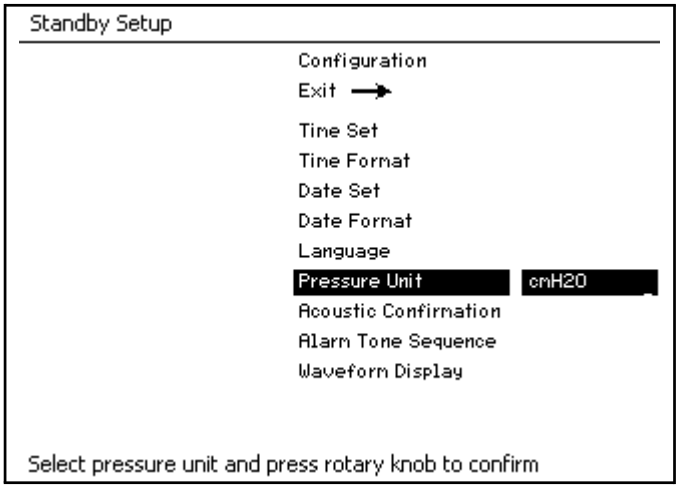
**Figure 175. Standby Setup Screen Configure Language Select**




### Pressure Unit

The values that can be selected are hPa (Hecto Pascal), $cmH_2O$ (centimeters of water), and mbar (millibar).

**Figure 176. Standby Setup Screen Configure Pressure Units**

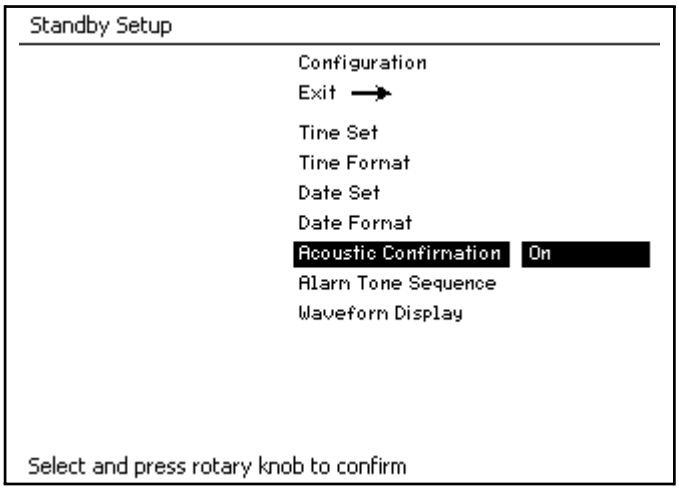


### Acoustic Confirmation

The values that can be selected are “On” and “Off”.

If “On” is selected, an acoustic confirmation is annunciated every time that the rotary knob is pressed.

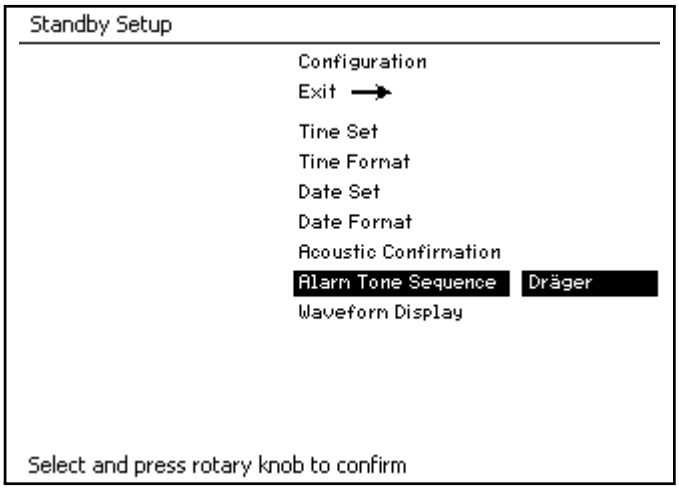
**Figure 177. Standby Setup Screen Configure Acoustic Confirmation**




### Alarm Tone Sequence

The values that you can select are ”Dräger” and “EN 740”.

**Figure 178. Standby Setup Screen Alarm Tone Sequence Select**



### Waveform Display

The values that you can select are “Normal” and “Filled”.

If “Normal” is selected, the waveform is not filled with a solid pattern, but appears as a line (**1** in Figure 180).

**Figure 179. Standby Setup Screen Waveform Display**

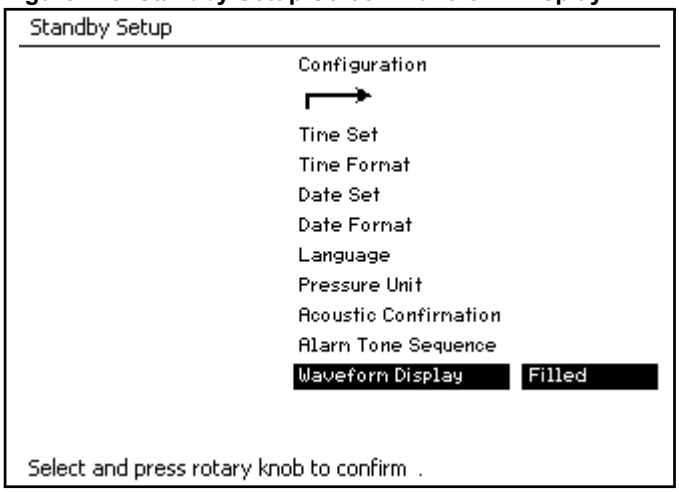
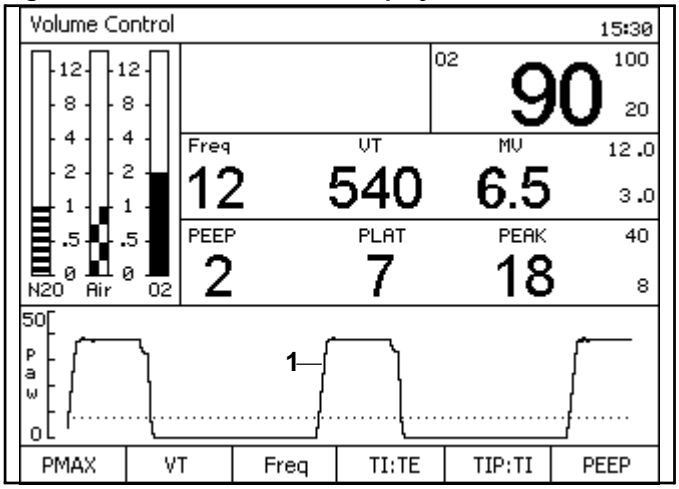



**Figure 180. Normal Waveform Display**



# Routine Maintenance and Cleaning

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# Routine Maintenance

Routine maintenance must be performed regularly to ensure safe and effective operation. Regularly check the condition of the absorbent and the overall condition of the machine, power cord, hoses, and breathing bag.

**Caution:** Risk of electric shock, do not remove cover. Refer servicing to a DrägerService representative.

## Disposal of Device

This device is subject to EU Directive 2002/96/EC (WEEE). It is not registered for use in private households, and may not be disposed of at municipal collection points for waste electrical and electronic equipment.

Dräger Medical has authorized a firm to dispose of this device in the proper manner; for more detailed information, please contact your local Dräger Medical organization.

## Disposal of Used Batteries and $O_2$ Sensors

- Batteries must be disposed of in conformity with the local waste disposal regulations.
- Spent $O_2$ sensors can be returned to Dräger Medical AG & Co. KG. Moislinger Allee 53 – 55 D-23542 Lübeck Germany
- Do not open forcibly: danger of chemical burns.
- Do not incinerate: danger of explosion.

## Disposal of Bacterial Filter

Must be disposed of as infectious special waste. Can be incinerated at temperatures above 800 °C with minimal environmental pollution.

# Disassembling

## Preparing the Compact Breathing System

1. Remove all breathing hoses.
2. Remove the breathing bag.
3. Remove both microbial filters and prepare in accordance with the specific Instructions for Use.

4. Remove the ventilation hose.
5. Remove the fresh gas hose from the breathing system.
6. Remove the anesthetic scavenging hose.
7. Detach the APL-bypass and the Peep/Pmax lines from the breathing system and from the side of the machine.
8. Remove the flow sensor cable.
9. Remove the $O_2$ sensor cable.
10. Turn off the optional Heated Breathing System Power Supply (HBSPS) power and disconnect the HBSPS power cable from the breathing system.
11. Remove the compact breathing system.

## Dismantling the Inspiratory Valve

1. Unscrew the retaining nut.
2. Remove the inspection cap.
3. Extract the valve disc.

## Dismantling the Expiratory Valve

1. Unscrew the retaining nut.
2. Remove the inspection cap.
3. Extract the valve disc.

## Dismantling the Flow Sensor

1. Loosen fitting on the expiration port.
2. Extract the flow sensor.

## Dismantling the APL-Valve

1. Unscrew the retaining nut.
2. Remove the APL-valve.
3. Unscrew the waste gas outlet port.

## Dismantling the Absorbent Canister

1. Turn the absorber counter-clockwise and remove by pulling down.
2. Empty the expired $CO_2$ absorbent from the absorber into an appropriate refuse container.

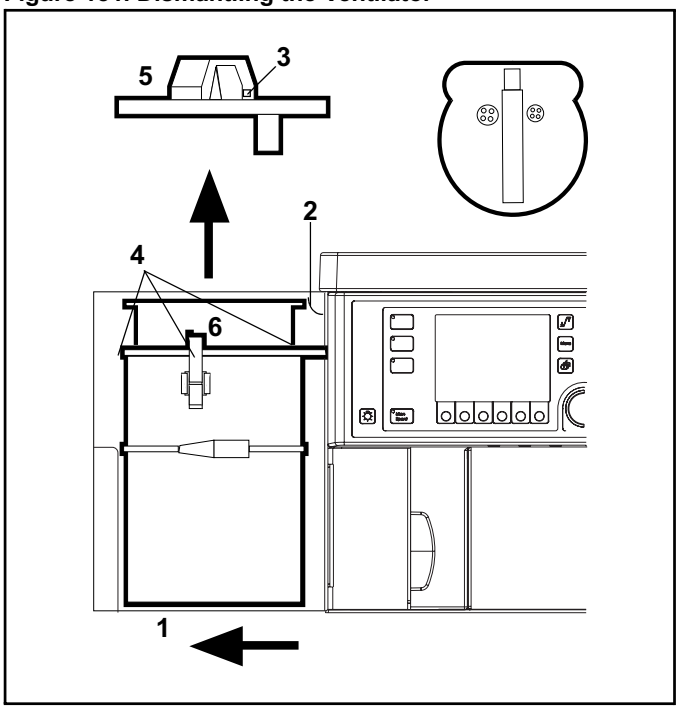
**Warning:** Absorbent is caustic and is a strong irritant to the eyes, skin, and respiratory tract. When replacing the absorbent, take care not to spill its caustic contents.

## Dismantling Parts of the Ventilator

The following numbers in boldface refer to Figure 181.

1. Swing out the ventilator door (**1**).
2. Disconnect the ventilator chamber pressure sensor line (**2**) from the ventilator chamber pressure sensor line port (**3**).
3. Unlock the three clasps (**4**) to remove the cover (**5**).
4. Remove the diaphragm (**6**).

**Figure 181. Dismantling the Ventilator**



## Disinfecting/Cleaning/Autoclaving

Clean and autoclave the Fabius Tiro Anesthesia Workstation and its parts according to the guidelines below. Follow your institution's policies regarding specific methods and agents for cleaning and sterilization. Determination of the need and frequency of sterilization of any particular component is the responsibility of the user institution.

Autoclaving procedures should be performed according to procedures established by the user institution following the specific instructions provided by the manufacturer of the sterilizing equipment or agent to be used. Such policies, procedures, and instructions should ultimately be consistent with established principles of clinical microbiology and infection control.

**Caution:** The exterior and certain other components of the anesthesia workstation consist of materials that are sensitive to certain organic solvents sometimes used for cleaning and disinfecting (e.g., phenols, halogen releasing compounds, oxygen releasing compounds, strong organic acids, etc.). Exposure to such substances may cause damage that is not always immediately apparent. Sterilization with ethylene oxide (EtO) or formaldehyde is also not permitted.

To prevent any damage, we recommend that only detergents and disinfectants are used that are compatible with the device, e.g. surface disinfectants on the basis of aldehydes, alcohols, or quarternary ammonium compounds for disinfection.

Ensure that all disinfectants are registered with the U.S. Environmental Protection Agency (or approved by your national authorities) for use as intended. Always follow the instruction labels specifically with respect to prescribed concentrations and the necessary exposure times.

Disinfectants often contain – besides their main active agents – additives that can also damage materials. When in doubt, ask the supplier/ manufacturer of the disinfectant/cleaning agent.

**Caution:** The Fabius Tiro and its components must not be treated with formaldehyde vapors or ethylene oxide!

**Warning:** Follow all of your accepted hospital procedures for disinfecting parts contaminated with body fluids (protective clothing, eye wear, etc.).

## Recommended Non-infectious Patient Equipment Schedules

A = Washing Machine (Wet pasteurisation at 70 °C, 158 °F, for 30 minutes after detergent cleaning)

B = Wiping (Glutaraldehyde-based formultations of 2%; ethyl or isopropyl alcohol at 70% to 90%; sodium hypochlorite (5.2% household bleach) 1:500 dilution (100 ppm free chlorine))

C = Immersion (Glutaraldehyde-based formultations of 2%)

D = Autoclaving (Including steam or hot air at 134 °C, 273 °F). Use your manufacturer's or your facility's recommendations.

1 = Per patient; 2 = Daily; 3 = Weekly; 4 = Monthly; * = Front daily, other surfaces weekly

**Caution:** Ensure that subsystems have been thoroughly aerated following cleaning and disinfection activities.

**Table 6. Schedules for Fabius Tiro Anesthesia Workstation with Non-infectious Patients**

| Components Processed | With Filter on Y-Piece | | | | With Filter on Inspiratory and Expiratory Port | | | | Without Filter | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | A | B | C | D | A | B | C | D |
| Workstation (outside) | | B * | | | | B * | | | | B * | | |
| Vaporizers | | B 2 | | | | B 2 | | | | B 2 | | |
| Power cable, gas supply hoses | | B 4 | | | | B 4 | | | | B 4 | | |
| Breathing bag and hose and Y-piece | A 2 | B 2 | | D 2 | A 2 | B 2 | | D 2 | A 1 | B 1 | | D 1 |
| Diaphragm | A 3 | | C 3 | D 3 | A 3 | | C 3 | D 3 | A 2 | | C 2 | D 2 |
| Breathing system | A 3 | | C 3 | D 3 | A 3 | | C 3 | D 3 | A 2 | | C 2 | D 2 |
| Valve discs | A 3 | | C 3 | D 3 | A 3 | | C 3 | D 3 | A 2 | | C 2 | D 2 |
| Ventilator cover | A 3 | | C 3 | D 3 | A 3 | | C 3 | D 3 | A 2 | | C 2 | D 2 |
| APL-valve | A 3 | | C 3 | D 3 | A 3 | | C 3 | D 3 | A 2 | | C 2 | D 2 |
| Exhaust port | A 3 | | C 3 | D 3 | A 3 | | C 3 | D 3 | A 2 | | C 2 | D 2 |
| Control lines and cables (outside) | | B 4 | | | | B 2 | | | | B 4 | | |
| Expiratory port | A 3 | | C 3 | D 3 | A 3 | | C 3 | D 3 | A 2 | | C 2 | D 2 |
| Absorber and insert | A 3 | | C 3 | D 3 | A 3 | | C 3 | D 3 | A 2 | | C 2 | D 2 |
| Flow sensor (outside) | | B 3 | C 3 | | | B 3 | C 3 | | | B 2 | C 2 | |
| AGS housing | A 3 | | C 3 | | A 3 | | C 3 | | A 3 | | C 3 | |
| AGS flow tube (no filter) | | B 3 | | | | B 3 | | | | B 3 | | |
| AGS buffer vol. container | A 3 | | C 3 | D 3 | A 3 | | C 3 | D 3 | A 3 | | C 3 | D 3 |
| AGS transfer hose | A 3 | | C 3 | | A 3 | | C 3 | | A 3 | | C 3 | |

## Recommended Infectious Patient Equipment Schedules

A = Washing Machine (Wet pasteurisation at 70 °C, 158 °F, for 30 minutes after detergent cleaning)

B = Wiping (Glutaraldehyde-based formultations of 2%; ethyl or isopropyl alcohol at 70% to 90%; sodium hypochlorite (5.2% household bleach) 1:500 dilution (100 ppm free chlorine))

C = Immersion (Glutaraldehyde-based formultations of 2%)

D = Autoclaving (Including steam or hot air at 134 °C, 273 °F). Use your manufacturer's or your facility's recommendations.

1 = Per patient; 2 = Daily; 3 = Weekly; 4 = Monthly; * = Front daily, other surfaces weekly

**Caution:** Ensure that subsystems have been thoroughly aerated following cleaning and disinfection activities.

**Warning:** When used with infectious patients, all parts in contact with breathing gas must additionally be autoclaved after cleaning and disinfection.

**Table 7. Schedules for Fabius Tiro Anesthesia Workstation with Infectious Patients**

| Components Processed | With Filter on Y-Piece | | | | With Filter on Inspiratory and Expiratory Port | | | | Without Filter | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | A | B | C | D | A | B | C | D |
| Workstation (outside) | | B * | | | | B * | | | | B * | | |
| Vaporizers | | B 2 | | | | B 2 | | | | B 2 | | |
| Power cable, gas supply hoses | | B 4 | | | | B 4 | | | | B 4 | | |
| Breathing bag and hose and Y-piece | A 1 | B 1 | | D 1 | A 1 | B 1 | | D 1 | A 1 | B 1 | | D 1 |
| Diaphragm | A 1 | | C 1 | D 1 | A 1 | | C 1 | D 1 | A 1 | | C 1 | D 1 |
| Breathing system | A 1 | | C 1 | D 1 | A 1 | | C 1 | D 1 | A 1 | | C 1 | D 1 |
| Valve discs | A 1 | | C 1 | D 1 | A 1 | | C 1 | D 1 | A 1 | | C 1 | D 1 |
| Ventilator cover | A 1 | | C 1 | D 1 | A 1 | | C 1 | D 1 | | | | D 1 |
| APL-valve | A 1 | | C 1 | D 1 | A 1 | | C 1 | D 1 | | | | D 1 |
| Exhaust port | A 1 | | C 1 | D 1 | A 1 | | C 1 | D 1 | | | | D 1 |
| Control lines and cables (outside) | | B 3 | | | | B 3 | | | | B 3 | | |
| Expiratory port | A 1 | | C 1 | D 1 | A 1 | | C 1 | D 1 | A 1 | | C 1 | D 1 |
| Absorber and insert | A 1 | | C 1 | D 1 | A 1 | | C 1 | D 1 | A 1 | | C 1 | D 1 |
| Flow sensor (outside) | | B 3 | C 3 | | | B 3 | C 3 | | | B 2 | C 2 | |
| AGS housing | A 1 | | C 1 | D 1 | A 1 | | C 1 | D 1 | A 1 | | C 1 | D 1 |
| AGS flow tube (no filter) | | B 1 | | D 1 | | B 1 | | D 1 | | B 1 | | D 1 |
| AGS buffer vol. container | A 1 | | C 1 | D 1 | A 1 | | C 1 | D 1 | A 1 | | C 1 | D 1 |
| AGS transfer hose | A 1 | | C 1 | D 1 | A 1 | | C 1 | D 1 | A 1 | | C 1 | D 1 |

# Maintenance Intervals

Clean and disinfect the machine and components before each service (and also when returning for repair).

## When Required

- Replace the $O_2$ sensor when calibration is no longer possible.
- Replace the flow sensor when calibration is no longer possible.
- Replace the pressure-measuring line (silicone rubber hose and sleeve).
- Replace APL-bypass, PEEP, and Pmax silicone rubber hoses.
- Replace filter - AGS

## Every 6 Months

Inspection and service by trained service personnel. Dräger recommends DrägerService.

- Fabius Tiro
- Breathing systems
- Vaporizer(s)
- Sensors
- Vamos

## Annually

- Replace the filter on the pressure-measuring line.
- Replace the diaphragm in the ventilator (patient).
- Replace vaporizer O-rings.

## After 3 Years

By trained service personnel:

- Replace the lead gel rechargeable battery for the back-up power supply.
- Replace the diaphragm and O-rings of the ventilator (piston).
- Replace breathing system canister assembly and associated seals.

# Checking Readiness for Operation

Refer to “Daily and Preuse Checkout Form” in Appendix A.

# Troubleshooting

## Contents

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**Table 8. Alarm Message, Probable Cause, and Remedy**

| Alarm Message | Probable Cause | Remedy |
|---|---|---|
| **AIRWAY PRESSURE HIGH** | Upper alarm limit for airway pressure has been exceeded, ventilation hose is kinked.<br>Alarm limit has been set too low. | Check hose system on anesthesia machine.<br><br>Check breathing circuit or alarm limit value. |
| **APNOEA FLOW** | Breathing/ventilation stops.<br>Leak or disconnect in breathing circuit. | Check ventilator.<br>Check breathing circuit. |
| **APNOEA PRESSURE** | Breathing/ventilation stops.<br>Leak or disconnect in breathing circuit. | Check ventilator.<br>Check breathing circuit. |
| **APNOEA VENTILATION** | Breathing/ventilation stops.<br>Leak or disconnect the breathing circuit.<br>Spontaneous patient breaths are not detected by the Fabius Tiro.<br>Pressure Support settings are incorrect. | Check ventilator.<br>Check breathing circuit.<br>A spontaneous patient breath is detected by the Fabius Tiro.<br>Check Pressure Support settings. |
| **BATTERY LOW** | AC failure and battery < 20 % = Advisory<br>AC failure and battery < 10 % = Caution | Restore mains power. |
| **CHECK APL VALVE** | APL bypass valve fault. | Check ventilator diaphragm and close cover.<br>Check APL bypass valve connection for disconnect or leak.<br>Select Standby Mode and switch back to the previous ventilation mode.<br>Check the APL valve setting. |
| **CHECK BATTERY** | UPS is not functional. | Replace fuse.<br>Call DrägerService (see “Daily and Preuse Checkout Form” for DrägerService contact information). |
| **CONTINUOUS PRESSURE** | Breathing pressure above threshold for more than 15 seconds. | Check breathing circuit. If in ManSpont mode, check fresh gas flow. |
| **EXP PORT LEAKAGE** | Expiratory flow of more than 15 mL measured during inspiration. | Check expiratory valve and valve disk.<br>Check tubing of expiration control line.<br>Follow the procedure to calibrate flow sensor.<br>Call DrägerService (see “Daily and Preuse Checkout Form” for DrägerService contact information). |
| **EXP PRESSURE HIGH** | Peep is more than 4 $cmH_2O$ (mbar, hPa) above the Peep setting in an automatic ventilation mode. | Check PEEP/PMAX, etc. hoses for kinks. |
| **FLOW SENSOR CAL DUE** | More than 18 hours passed since last flow sensor calibration.<br>Cable has been removed and reconnected. | Follow the procedure to calibrate flow sensor. |
| **FLOW SENSOR FAIL** | Flow sensor has not been properly calibrated.<br>Sensor faulty. | Follow the procedure to calibrate sensor.<br>Replace sensor and calibrate.<br>Call DrägerService (see “Daily and Preuse Checkout Form” for DrägerService contact information). |
| **FRESH GAS LOW** | Inadequate fresh-gas supply.<br>Blocked/kinked hose.<br>Leak or disconnect in breathing circuit. | Ensure adequate fresh-gas supply.<br>Check hoses.<br>Check breathing circuit. |
| **INSP O2 HIGH** | Inspiratory $O_2$ concentration exceeds the upper alarm limit. | Check flowmeter settings and $O_2$ high alarm limit. |

| Alarm Message | Probable Cause | Remedy |
|---|---|---|
| **INSP O2 LOW** | Inspiratory $O_2$ concentration is below lower alarm limit. | Check $O_2$ supply. Check flowmeter settings and $O_2$ low alarm limit. |
| **INSP PRES NOT REACH** | Set pressure not achieved while ventilating in Pressure Control, Pressure Support, or SIMV/PS mode. | Check ventilator, patient circuit, and Pinsp settings. |
| **MINUTE VOLUME HIGH** | Minute volume has exceeded upper alarm limit.<br>Flow sensor has not been calibrated.<br>Sensor faulty. | Calibrate flow sensor.<br><br>Replace if necessary. |
| **MINUTE VOLUME LOW** | Minute volume has fallen below lower alarm limit.<br>Blocked/kinked hose.<br>Leak in breathing system.<br>Reduced volume due to pressure limitation.<br>Reduced lung compliance.<br>Flow sensor not calibrated or faulty. | Check breathing circuit and alarm limit.<br><br>Check breathing circuit.<br>Check breathing system.<br>Check Pmax setting on ventilator control panel.<br><br>Check ventilator settings.<br>Follow the procedure to calibrate flow sensor and replace if necessary. |
| **NO FRESH GAS** | Inadequate fresh-gas supply.<br>Fresh-gas control valve closed | Ensure adequate fresh-gas supply.<br>Open fresh-gas control valve. |
| **O2 SENSOR CAL DUE** | More than 18 hours passed since last oxygen sensor calibration. | Follow the procedure to calibrate oxygen sensor. |
| **O2 SENSOR FAIL** | $O_2$ sensor has not been correctly calibrated.<br>$O_2$ sensor replaced and/or not calibrated.<br>$O_2$ sensor used up.<br>$O_2$ sensor disconnected.<br>Faulty sensor cable. | Follow the procedure to calibrate $O_2$ sensor.<br><br>Follow the procedure to calibrate $O_2$ sensor.<br>Replace sensor capsule and calibrate.<br>Connect $O_2$ sensor assembly.<br>Replace $O_2$ sensor housing assembly. |
| **O2 SUPPLY LOW** | $O_2$ supply line has less than minimum pressure permitted (approximately 20 psi). | Check $O_2$ supply and cylinder backup. |
| **PEEP HIGH** | Peep is higher than 4 $cmH_2O$ (mbar, hPa) in ManSpont mode. | Check APL-valve setting and/or fresh gas flow. |
| **POWER FAIL** | Mains not connected.<br>Facility power failure. | Connect mains. |
| **PRES APNOEA ALARM OFF** | Pressure alarms off in ManSpont. | |
| **PRESSURE LIMITING** | Measured pressure equals or exceeds Pmax ventilator setting. | Check ventilator and Pmax settings. |
| **PRESSURE NEGATIVE** | Measured breathing pressure is less than –5 $cmH_2O$ (mbar, hPa). | Check breathing circuit and ventilator settings. |
| **PRESSURE SENSOR FAIL** | Faulty sensor or pressure not calibrated. | Call DrägerService (see “Daily and Preuse Checkout Form” for DrägerService contact information). |
| **PRES THRESHOLD LOW** | Ventilation parameters were changed without changing alarm settings. | Push the Auto Set soft key and check ventilator settings. |
| **RS232 COM1 FAIL** | External monitor cable disconnected from External Communication Port 1. | Check monitor interface cable. |
| **RS232 COM2 FAIL** | External monitor cable disconnected from External Communication Port 2. | Check monitor interface cable. |

| Alarm Message | Probable Cause | Remedy |
|---|---|---|
| **SPEAKER FAIL** | Speaker failed. | Call your DrägerService (see "Daily and Preuse Checkout Form" for DrägerService contact information). |
| **VENTILATOR FAIL** | Ventilator not assembled correctly. | Check diaphragm and close cover.<br>Check PEEP/PMAX line for disconnect or leak.<br>Select Standby Mode and switch back to the previous ventilation mode. |
| **VOLUME ALARMS OFF** | Volume alarms turned off by operator. | |

# Components

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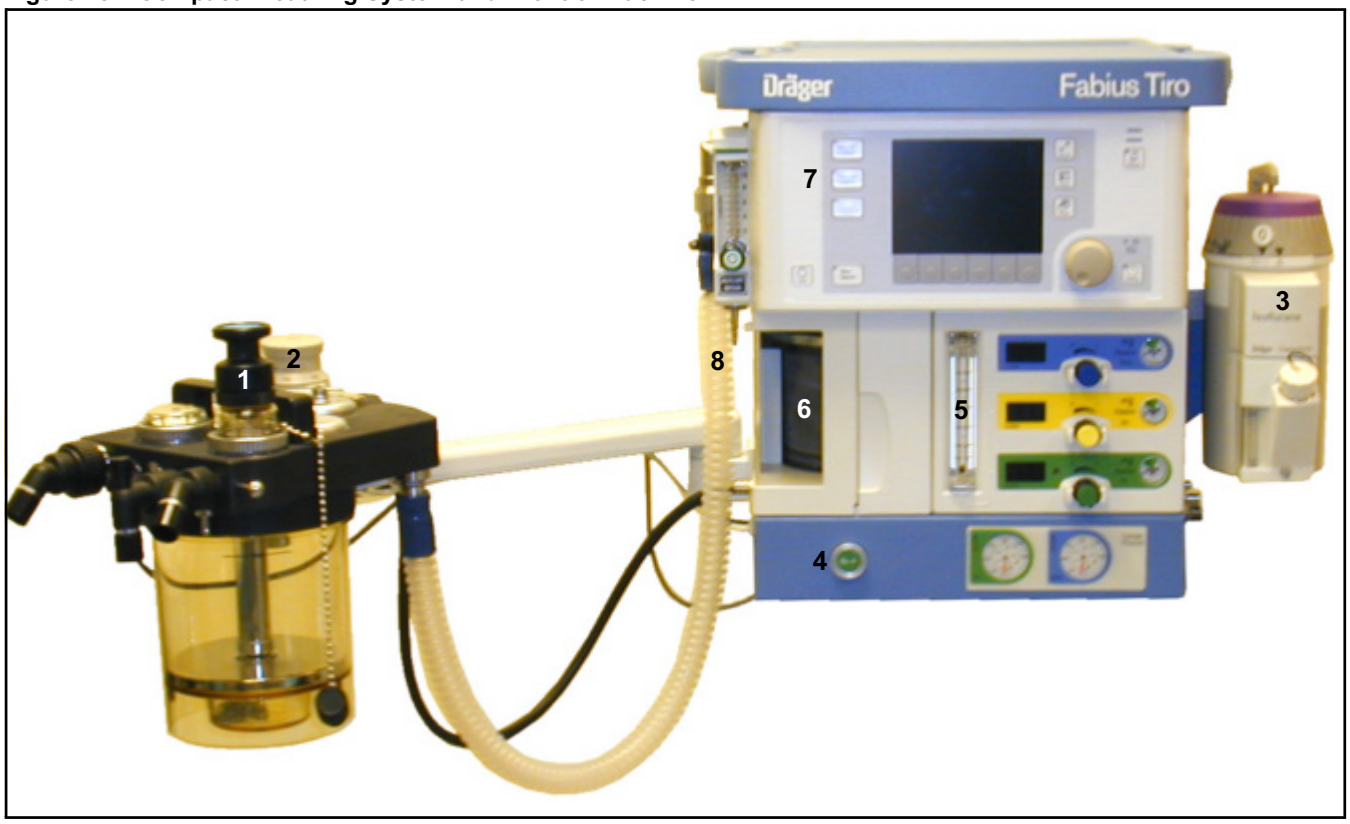
## Front View

**Figure 182. Compact Breathing System and Front of Machine**




1 $O_2$ sensor on inspiratory valve

2 Selection knob for **MAN** and **SPONT** on APL valve

3 Dräger Vapor anesthetic agent vaporizer

4 Oxygen flush

5 Total fresh gas flowmeter

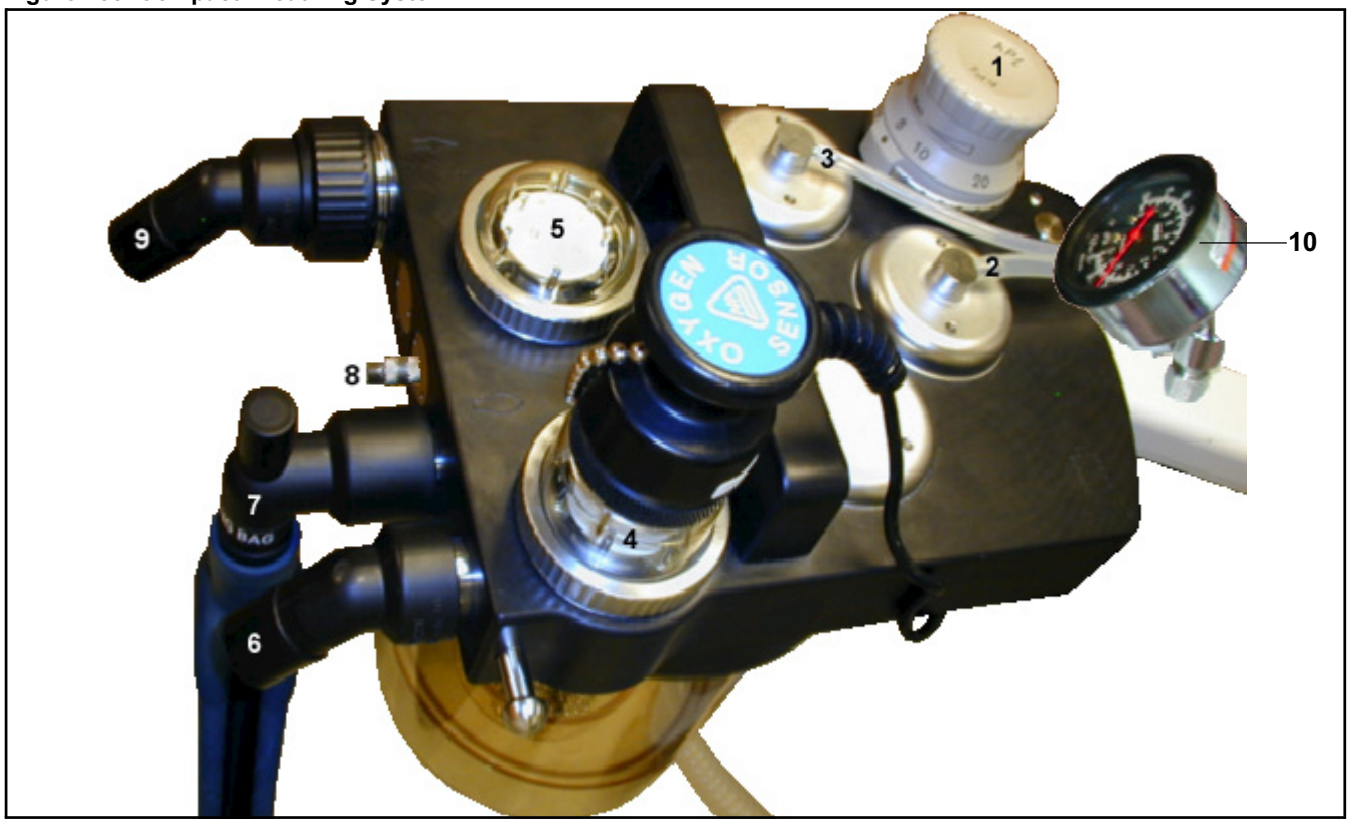
6 Ventilator

7 Ventilator control panel (settings for ventilation parameters and airway monitoring)

8 Ventilator hose

# Compact Breathing System (Top View)

**Figure 183. Compact Breathing System**




1 Selection knob for **MAN** and **SPONT** on APL valve

2 APL Bypass valve connection port

3 PEEP/PMAX valve connection port

4 Inspiratory valve

5 Expiratory valve

6 Inspiratory port

7 Connector for breathing bag

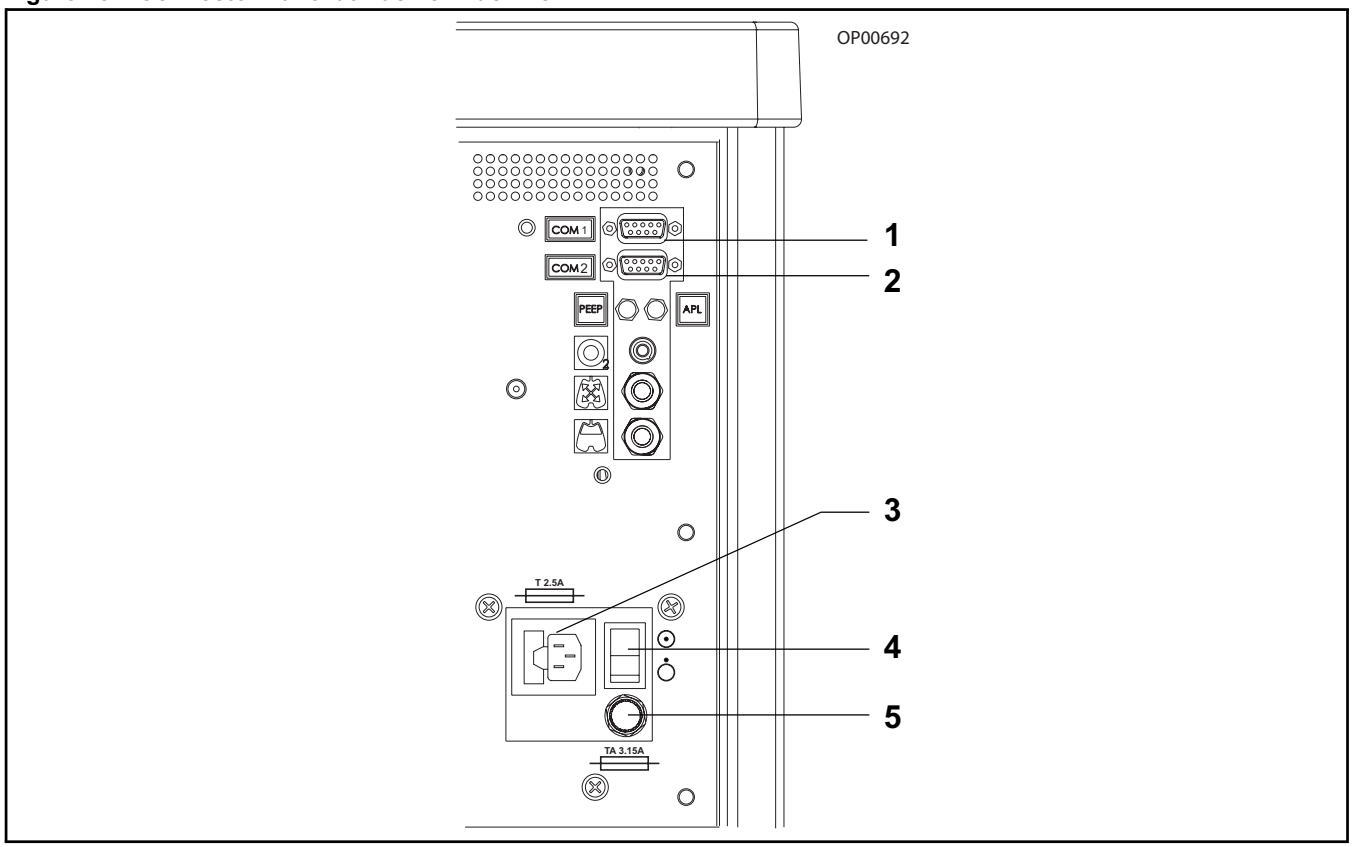
8 Sample gas return port

9 Expiration port

10 Airway Pressure Gauge (Optional)

# Rear View (Connector Panel)

**Figure 184. Connector Panel at Back of Machine**




1 COM1 RS-232 port

2 COM2 RS-232 port (optional)

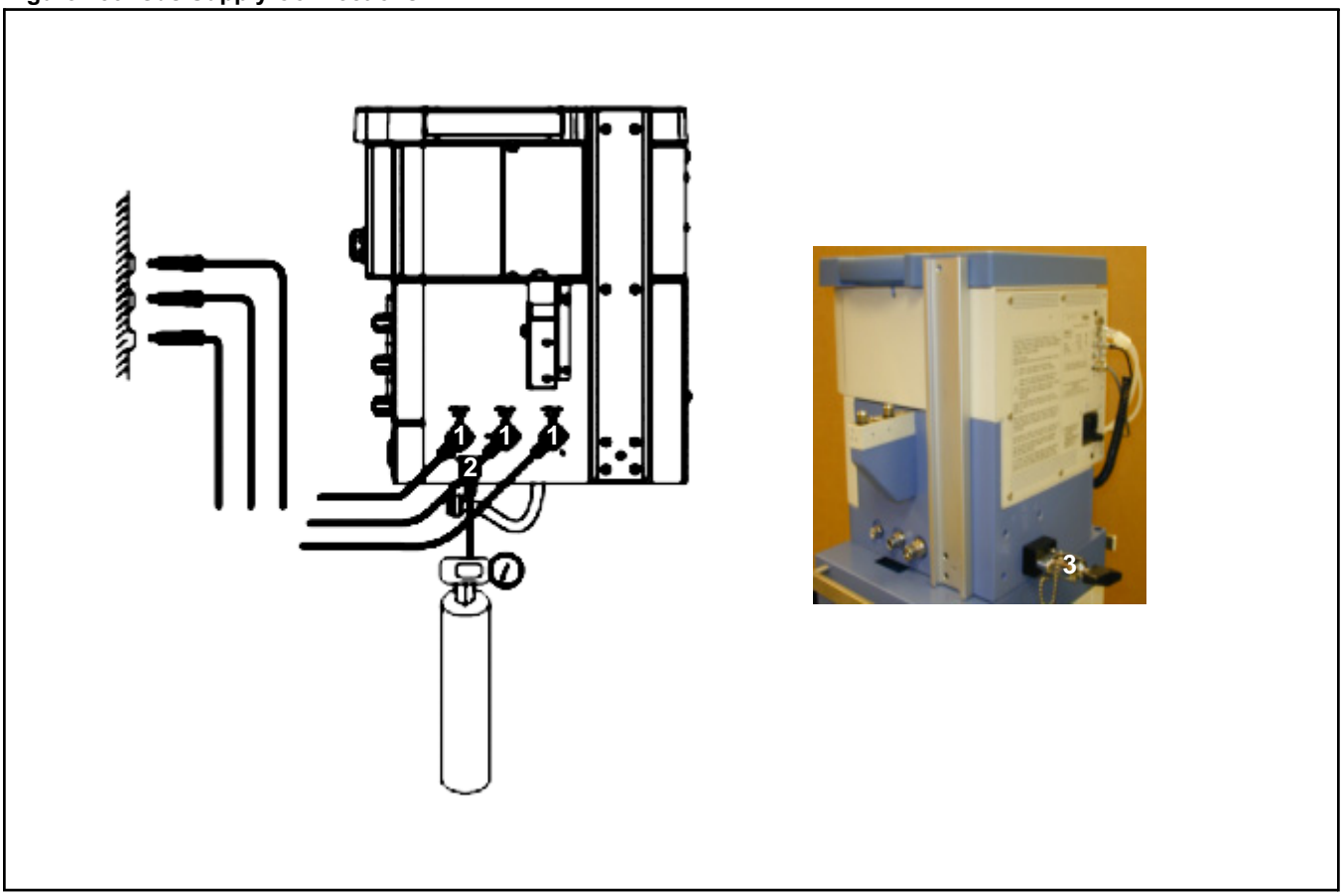
3 Power cable connection

4 On/off switch

5 Battery fuse

## Gas Supply Connections

**Figure 185. Gas Supply Connections**




1 Connectors for medical gas pipeline supply (central supply)

2 Connector for $O_2$ cylinder with threaded connector

3 Connector for gas cylinder supply (reserve supply) (trolley mount only)

# Technical Data

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# Technical Data

## Ambient Conditions

**During operation**

| | |
|---|---|
| Temperature | 10 to 35 °C |
| Atmospheric pressure | 700 to 1060 cm$H_2O$ (hPa, mbar) |
| Relative humidity | 20 to 80% (no condensation) |

**During storage**

| | |
|---|---|
| Temperature | –10 to 60 °C |
| Atmospheric pressure | 700 to 1060 cm$H_2O$ (hPa, mbar) |
| Relative humidity | 10 to 90% (no condensation) |

The service conditions for supplementary equipment must be noted. These may restrict the area of use for the system as a whole. Vaporizer units and the anesthetic agents used may restrict the area of use of the workstation in regards to its temperature range and maximum fresh-gas flow. The corresponding Instructions for Use of the supplementary equipment must be noted.

## Machine Data

**Gas supply from medical gas pipeline system**

| | |
|---|---|
| Pipeline System Pressure Range at Machine Connector | |
| $O_2$, $N_2O$, Air: | 41 to 87 psi (2.8 to 6 bar)<br>Note: Pipeline system supply pressure variation shall not exceed ±10% |
| Gas supply connectors:<br>Each inlet is fitted with a non-return valve | NIST or DISS (where required) |
| Pipeline Pressure Indicator Accuracy | ±3% of full scale from 40 to 120 psi (2.7 to 8 bar) |

**Gas supply from supplementary $O_2$ and $N_2O$ cylinders** (with threaded NIST connections)

| | |
|---|---|
| Pressure at machine connector | |
| $O_2$, $N_2O$<br>Each inlet is fitted with a non-return valve | 73 psi (5 bar) max. |

**Gas supply from supplementary $O_2$ and $N_2O$ cylinders** (with pin-index connections)

| | | |
|---|---|---|
| Cylinder Connections | Pin-indexed hanger yokes (CGA V-1-1994) | |
| Cylinder Gas Pressure<br>(typical full loads at 70 ºF, 21 ºC) | $O_2$<br>$N_2O$ | 1900 psi (131 bar)<br>745 psi (51.3 bar) |
| Cylinder Gauges | Conform to ASME B40.1 Grade B | |
| Cylinder Gauge Range | $O_2$<br>$N_2O$ | 0 to 3000 psi (206.8 bar)<br>0 to 3000 psi (206.8 bar) |

**Compressed gas supply at workstation inlet**

| | |
|---|---|
| Dew point | >5 °C at ambient temperature |
| Oil content | <0.1 mg/$m^3$ |
| Particles | dust-free air (filtered with pores <1 x$10^{-6}$m) |

| | |
|---|---|
| **Internal Regulator Safety Relief Valve Pressure** | 70 psi (4.8 bar) |

**During operation**

**Protection Class** I, in accordance with EN 60601-1

**Dimensions (Approximate)**

*** Note:** Width may vary with COSY arm position.

| | |
|---|---|
| Trolley Mount without COSY | (W) 22.8 in. x (H) 53.6 in. x (D) 24.7 in.<br>(W) 57.9 cm x (H) 136.1 cm x (D) 62.7 cm |
| Trolley Mount with COSY* | (W) 30.4 in. x (H) 53.6 in. x (D) 33.0 in.<br>(W) 77.2 cm x (H) 136.1 cm x (D) 83.8 cm |
| Wall Mount without COSY | (W) 20.8 in. x (H) 21.9 in. x (D) 17.4 in.<br>(W) 52.8 cm x (H) 55.6 cm x (D) 44.2 cm |
| Wall Mount with COSY* | (W) 28.4 in. x (H) 21.9 in. x (D) 30.5 in.<br>(W) 72.1 cm x (H) 55.6 cm x (D) 77.5 cm |

**Weight (Approximate)**

**Note:** The following weights exclude weights of supplementary cylinders and vaporizers.

**Fabius Tiro Wall Mount**

| | |
|---|---|
| Fabius Tiro Core Module | 64.0 lbs. / 29.0 kg |
| COSY | 15.5 lbs. / 7.0 kg |
| Wall Mount Bracket | 26.0 lbs. / 11.8 kg |
| Fabius Tiro Wall Mount Total | 105.5 lbs. / 47.8 kg |

**Fabius Tiro Trolley Mount**

| | |
|---|---|
| Fabius Tiro Core Module with two pin index cylinder yokes | 69.5 lbs. / 31.5 kg |
| COSY | 15.5 lbs. / 7.0 kg |
| Trolley | 120.0 lbs. / 54.4 kg |
| Fabius Tiro Trolley Mount Total | 205.0 lbs. / 92.9 kg |

**Power supply**, Rating Non-configurable 100 to 240 VAC, 50/60 Hz., 2.3 A maximum

**Rechargeable batteries**

| | |
|---|---|
| Rating: | 24 V; 3.5 Ah |
| Type: | sealed, gelled lead-acid |
| Recharging time: | ≤16 hours on the mains or full operation time |
| Operation time with fully charged batteries: | 45 minutes, minimum |

## Fuses

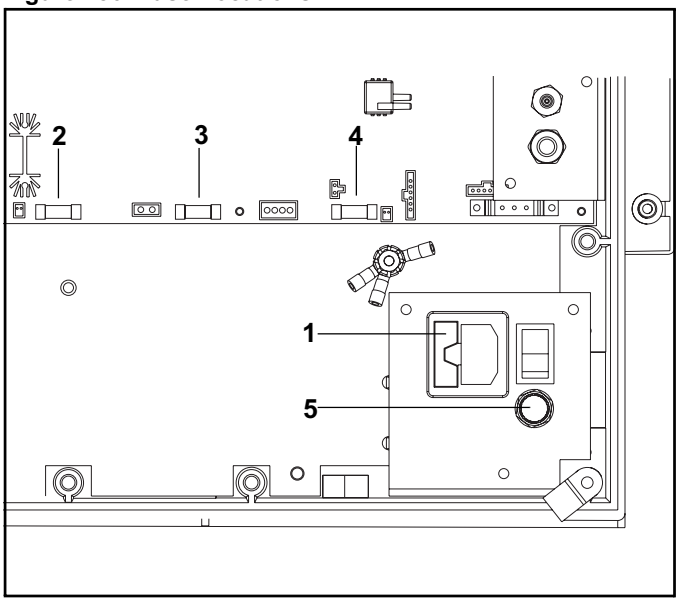
The following numbers in boldface refer to Figure 186.

Mains fuses: (**1**)
For 100 to 240V supply voltage:
2x T2.5AL 250V IEC 127/III

Fuses located on circuit board:
1x T1.6AL 250V IEC 127/III (**2**)
1x T4AL 250V IEC 127/III (**3**)
1x T2.5AL 250V IEC 127/III (**4**)

Battery fuse:
1x T3.15AL 250V IEC 127/III (**5**)

**Figure 186. Fuse Locations**




## Electromagnetic Compatibility (EMC)

Conforming to EN 60601-1-2, 2001 and IEC 60601-1-2, 2001

The operation of this anesthetic workstation or module may be adversely affected by electromagnetic interference exceeding the levels specified in EN 60601-1-2 and IEC 60601-1-2.

## Electrical Safety Conformance

Conforms to:

- UL2601
- IEC 60601-1, 1996
- CAN/CSA No. 601-1
- CAN/CSA-C22.2 No. 601.1-M90
- EN 740, 1998
- IEC 60601-2-13

## Ventilator

### Control Inputs Ranges

Note: * $cmH_2O$ (hPa, mbar)

| | | |
|---|---|---|
| PMAX | Pressure limiting | 15 – 70 $cmH_2O$* (1 $cmH_2O$* resolution)<br>(PMAX setting must be at least 10 $cmH_2O$ above PEEP; and in SIMV/PS mode, the PMAX setting must also be greater than ∆ PPS+PEEP) |
| VT | Tidal volume | 20 to 1400 mL (10 mL resolution) |
| VT (SIMV/PS) | Tidal volume | 20 to 1100 mL (10 mL resolution) |
| f | Breathing frequency | 4 to 60 bpm (1 bpm resolution) |
| Ti/Te | Inspiration/expiration ratio | 4 : 1 to 1 : 4 |
| Tip/Ti | Inspiration pause | 0% to 50% (1% resolution) |
| PEEP | End-expiratory pressure | 0 to 20 $cmH_2O$* (1 $cmH_2O$* resolution) |
| Pinsp | Inspiratory pressure | 5 to 65 $cmH_2O$* (1 $cmH_2O$* resolution)<br>(Pinsp setting must be at least 5 $cmH_2O$ above PEEP) |
| Insp Flow | Inspiratory flow | 10 to 75 L/min (1 L/min resolution) in Pressure Control mode<br>10 to 85 L/min (1 L/min resolution) in PS and SIMV/PS modes |
| ∆ PPS (Pressure Support) | Support Pressure | 3 to 20 $cmH_2O$ (1 $cmH_2O$* resolution) |
| ∆ PPS (SIMV/PS) | Support Pressure | 3 to 20 $cmH_2O$, OFF (1 $cmH_2O$* resolution) |
| Freq Min | Apnoea Ventilation minimum frequency | 3 to 20 bpm (1 bpm resolution) and “OFF” |

### Pressure Support Ventilation Mode

The Pressure Support Ventilation mode has been verified under the following range of simulated patient conditions:

| | |
|---|---|
| Endotracheal Tube Size: | 4.5 mm to 8 mm |
| Patient Lung Compliance: | 10 mL/$cmH_2O$ to 100 mL/$cmH_2O$ |
| Unassisted Patient Tidal Volume: | 50 mL to 1000 mL |
| Patient Breath Rate (BPM): | 10 to 35 |

### Delivery Accuracy

| | | |
|---|---|---|
| PMAX | Pressure limiting | ±5 $cmH_2O$* of setting |
| VT | Tidal volume | ±5% of setting or 20 mL, whichever is greater<br>(discharged to atmosphere, no compliance compensation) |
| f | Breathing frequency | ±1 bpm of setting |
| Ti/Te | Inspiration/expiration ratio | ±5% of setting |
| Tip/Ti | Inspiration pause | ±25% of setting |
| PEEP | End-expiratory pressure | ±2 $cmH_2O$* or ±20% of setting, whichever is greater |

### High Pressure Safety Relief Valve

75 ±5 $cmH_2O$ (hPa, mbar)

**Negative Pressure Safety Relief Valve (Ambient Air Inlet Valve)**

–7.5 to –9 $cmH_2O$ (hPa, mbar)

**System Compliance Compensation Measurement**

| | |
|---|---|
| 0.2 to 6.0 ml/$cmH_2O$ | ±0.2 ml/$cmH_2O$ or ±10% of actual compliance, whichever is greater |

## Anesthesia Gas Supply Module

**Fresh Gas Flow Indicators:**

| | |
|---|---|
| $O_2$, $N_2O$, Air: | Range and accuracy: 0.0 to 12.0 L/min ±10% of reading or 0.12 L/min (into an ambient atmosphere of 14.7 psi (101.3 kPa) at 20 °C).<br>Resolution: 0.1 L/min. |

**Fresh Gas Flow Stability:**
$O_2$ and $N_2O$: ±10% of setting with pipeline pressures between 45 to 65 psi
Air ±10% of setting with pipeline pressures between 50 to 55 psi
Air flow rate will vary proportionally with supply pressures outside 50 to 55 psi.

**Total Fresh Gas Flowmeter:**

| | |
|---|---|
| Range and accuracy: | 0 to 10 L/min ± 10% of full scale at STP,<br>calibrated with 50% $O_2$ / 50% $N_2O$ gas mixture<br>0 to 10 L/min ± 15% of full scale at STP for all other gas mixtures |
| Resolution: | 0.5 L/min from 0.5 to 2 L/min<br>1.0 L/min from 2 to 10 L/min |
| **$O_2$ flush (bypass):** | at 55 psi (3.8 bar): max. 50 L/min<br>at 50 psi (3.4 bar): min. 35 L/min |

**Common Gas Outlet Pressure Limit:** 13 psi (0.9 bar), maximum

## Anesthetic Agent Vaporizer Interface

Dräger Vapor quick-change plug-in system for one anesthetic agent vaporizer.

The connections are automatically closed and sealed when the vaporizer is removed.

Dräger Halothane Vapor
Dräger Enflurane Vapor
Dräger Isoflurane Vapor
Dräger Sevoflurane Vapor
Datex-Ohmeda Devapor/D-Tec for Desflurane
Dräger D-Vapor

See specific Instructions for Use manuals for technical data of anesthetic agent vaporizers.

| Monitoring and Measurement Display | | Range | Resolution | Accuracy | Condition |
|---|---|---|---|---|---|
| Paw | Airway pressure (numeric) | –20 to 99 $cmH_2O$** | 1 $cmH_2O$** | ±4%* | |
| | Airway pressure (wave) | 0 to 99 $cmH_2O$** | | | |
| Ve | Expiratory minute volume | 0 to 99.9 L/ min | 0.1 L/ min | ±15%† | ATPS‡ |
| | Expiratory tidal volume | 0 to 1500 mL | 1 mL | ±15%† or ±20 mL, whichever is greater | ATPS‡ |
| | Note: For end-tidal values of Desflurane exceeding 12%, tidal and minute volume accuracies may exceed ±15% | | | | |
| f | Breathing frequency | 2 to 99 bpm | ±1 bpm | ±1 bpm | |
| $FiO_2$ | $O_2$ measurement in the main gas flow | 10 to 100 vol.% | 1 vol.% | ±3 vol.% | with reference to ambient pressure during calibration |
| | Response time | Less than 25 seconds | | | |
| | Service life of $O_2$ sensor cell | ≥8 months at 25 °C, 50% relative humidity, 50% $O_2$ gas mixture (or ≥5000% hour $O_2$) | | | |

** $cmH_2O$ (hPa, mbar)

* Max. ±4% of the measured value or ±2 $cmH_2O$, whichever is greater.

† At standard test conditions per EN740 Annex DD and fresh gas flow = 2 times Ve.

‡ ATPS = Ambient Temperature Pressure Saturated Gas

## Breathing System

| | Compact Breathing System<br>Volume: 2.8 L + bag<br>Compliance§: 0.22 mL/cm$H_2O$*<br>Absorber volume: 1500 mL | | | Drägersorb CLIC Adapter and Breathing System<br>Volume with canister: 2.4 L + bag<br>Volume without canister: 0.9 L + bag<br>Compliance with canister§: 0.22 mL/cm$H_2O$*<br>Compliance without canister§: 0.22 mL/cm$H_2O$*<br>Absorber volume with canister: 1300 mL<br>Absorber volume without canister: 0 mL | | |
|---|---|---|---|---|---|---|
| | **Resistance of Breathing System** | | | **Resistance of Breathing System** | | |
| | **5 L/min** | **30 L/min** | **60 L/min** | **5 L/min** | **30 L/min** | **60 L/min** |
| **Inspiratory Resistance** | 0.5 cm$H_2O$* | 1.3 cm$H_2O$* | 2.8 cm$H_2O$* | 0.5 cm$H_2O$*†<br>0.5 cm$H_2O$*‡ | 1.0 cm$H_2O$*†<br>1.0 cm$H_2O$*‡ | 1.5 cm$H_2O$*†<br>1.5 cm$H_2O$*‡ |
| **Expiratory Resistance** | 0.7 cm$H_2O$* | 2.4 cm$H_2O$* | 4.8 cm$H_2O$* | 0.5 cm$H_2O$*†<br>0.5 cm$H_2O$*‡ | 1.4 cm$H_2O$*†<br>1.1 cm$H_2O$*‡ | 2.4 cm$H_2O$*†<br>1.8 cm$H_2O$*‡ |

§ Compliance in automatic mode (Volume Control). Compliance exclusive of patient hoses.
Note: Resistance tests in compliance with EN740-107.4.2.1
* cm$H_2O$ (hPa, mbar), Dry
† Resistance of Drägersorb CLIC Adapter and breathing system **with** canister
‡ Resistance of Drägersorb CLIC Adapter and breathing stem **without** canister

**Classification** **II b**
Conforming to Directive 93/42/EEC Appendix IX

**UMDNS Code** **10-134**
Universal Medical Device Nomenclature System

**Control Inputs Ranges**
APL-Valve MAN mode 5 to 70 cm$H_2O$
SPONT mode 1.5 cm$H_2O$

**Pressure Required to Open a Wet Unidirectional Valve**
Moist: 1.5 cm$H_2O$
(Tested in accordance with EN740)

**Pressure Generated by a Wet Unidirectional Valve**
Moist: 3.1 cm$H_2O$ (Tested in accordance with EN740)

## HBSPS Technical Data (Optional)

The Fabius Tiro can be configured with a heated breathing system to reduce condensation of moisture in the system.

**Electrical**

AC Input Voltage and Current

100 to 240 VAC, 50 to 60 Hz nominal, single phase, 0.6 Amps max.

DC Output

15Vdc ±5%, 1.3 Amps

Fuses

- 2x T1.0AL 250V IEC 127/III
- 1x F1.60AH 250V IEC 127/II

Electromagnetic Compatibility (EMC)

Conforming to EN 60601-1-2, IEC 60601-1-2, and ANSI/AAMI/IEC 60601-1-2

Electrical Safety Conformance

- IEC 60601-1
- CAN/CSA C22.2 No. 601.1-M90
- UL 60601-1

**Environmental**

| | |
|---|---|
| Temperature | |
| Operating | +10 °C to +35 °C |
| Storage | -10 °C to +70 °C |
| Humidity | |
| Operating | 20% to 80% non-condensing |
| Storage | 10% to 90% non-condensing |
| Barometric Pressure | |
| Operating | 700 to 1060 mbar |
| Storage | 500 to 1060 mbar |

## Low Oxygen Supply Pressure Alarm

| | |
|---|---|
| Alarm limit | Warning signal when the pressure drops below 20 ±4 psi (1.4 ±0.3 bar) |
| Alarm signal | High priority alarm (Warning) |
| LED indicator | The red LED indicator in the $O_2$ area of the gas flow control interface will flash until the $O_2$ supply is restored. |

## S-ORC (Sensitive Oxygen Ratio Controller)

S-ORC is a control element which guarantees a minimum $O_2$ concentration in the fresh gas flow. At a flow rate of approx. 200 mL/min., the $N_2O$ concentration in the fresh gas can be freely set between 0 and 75%.

| | |
|---|---|
| During $O_2$ shortage | S-ORC limits the $N_2O$ concentration in the fresh gas, so that the $O_2$ concentration does not drop below 23 vol.%. |
| $N_2O$ metering valve open and $O_2$ metering valve closed or $O_2$ flow less than 0.2 L/min | S-ORC prevents $N_2O$ flow |
| During $N_2O$ failure | $O_2$ may still be administered. No alarm. |

## Fresh Gas Flow Indicators ($O_2$, $N_2O$, Air)

Range: 0.0 to 12.0 L/min, minimum

Resolution: 0.1 L/min

Accuracy (into an ambient atmosphere of 14.7 psi (101.3 kPa): ±10% or 0.12 L/min, whichever is greater. at 20 °C.

## Serial Interface

Type: RS-232

Baud Rates: 1200, 2400, 4800, 9600, 19.2K, 38.4K

Parity: Odd, Even, None

Data Bits: 7 or 8

Stop Bits: 1 or 2

Protocol: Vitalink. Medibus

# Diagrams

**Figure 187. Gas flow diagram (Compact Breathing System)**

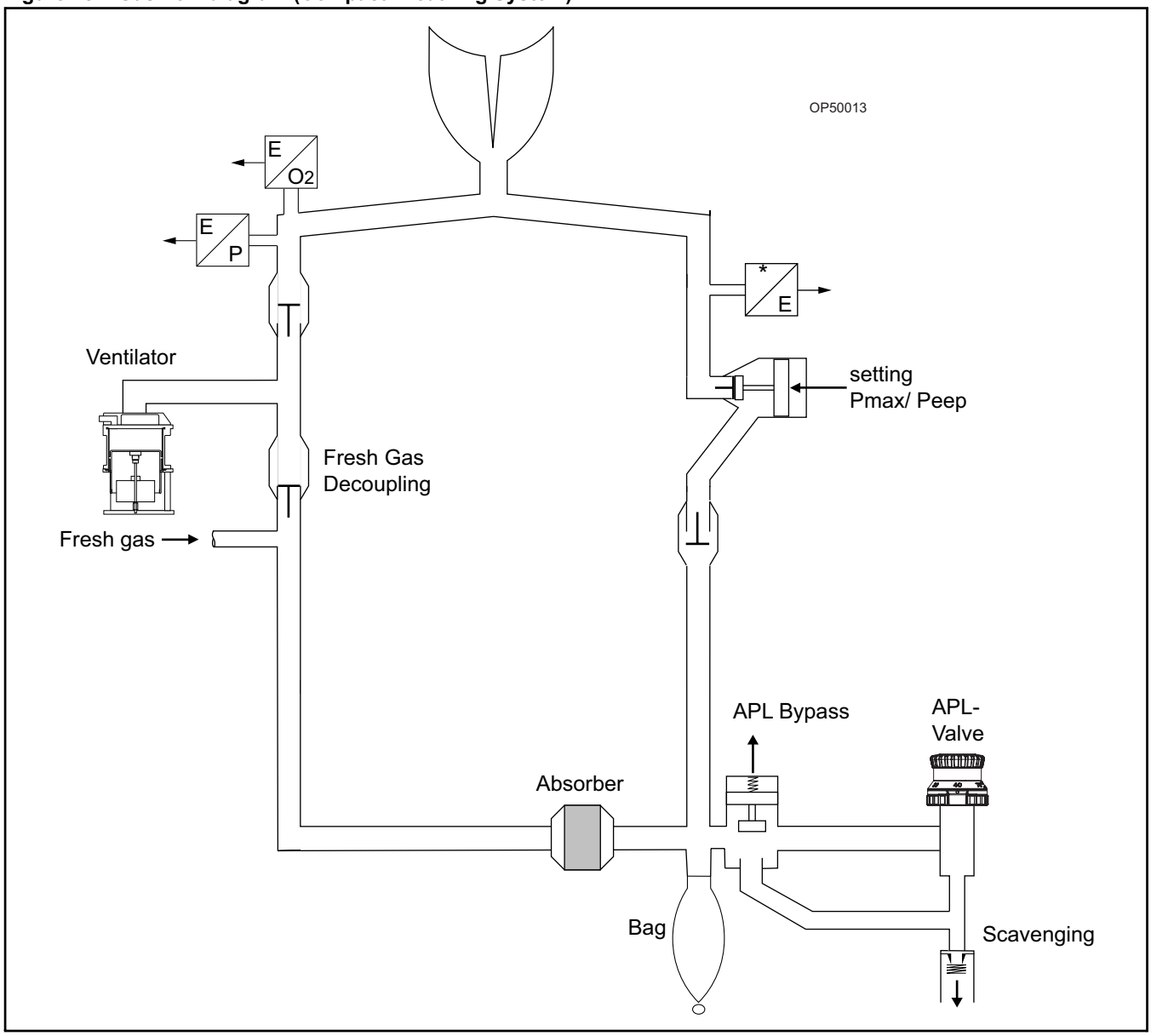


**Figure 188. Gas Flow Diagram (Semi-Open Compact Breathing System)**

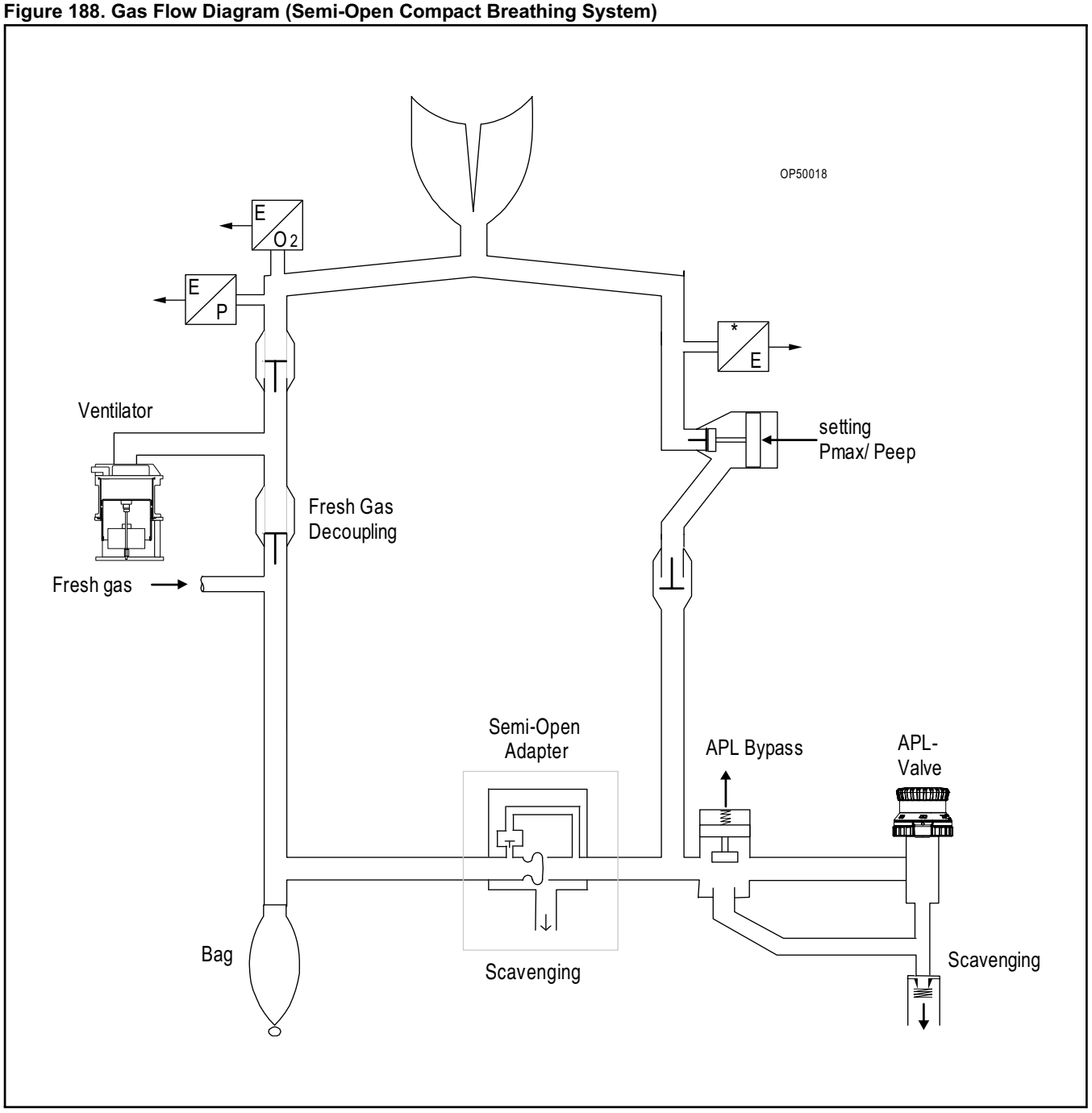
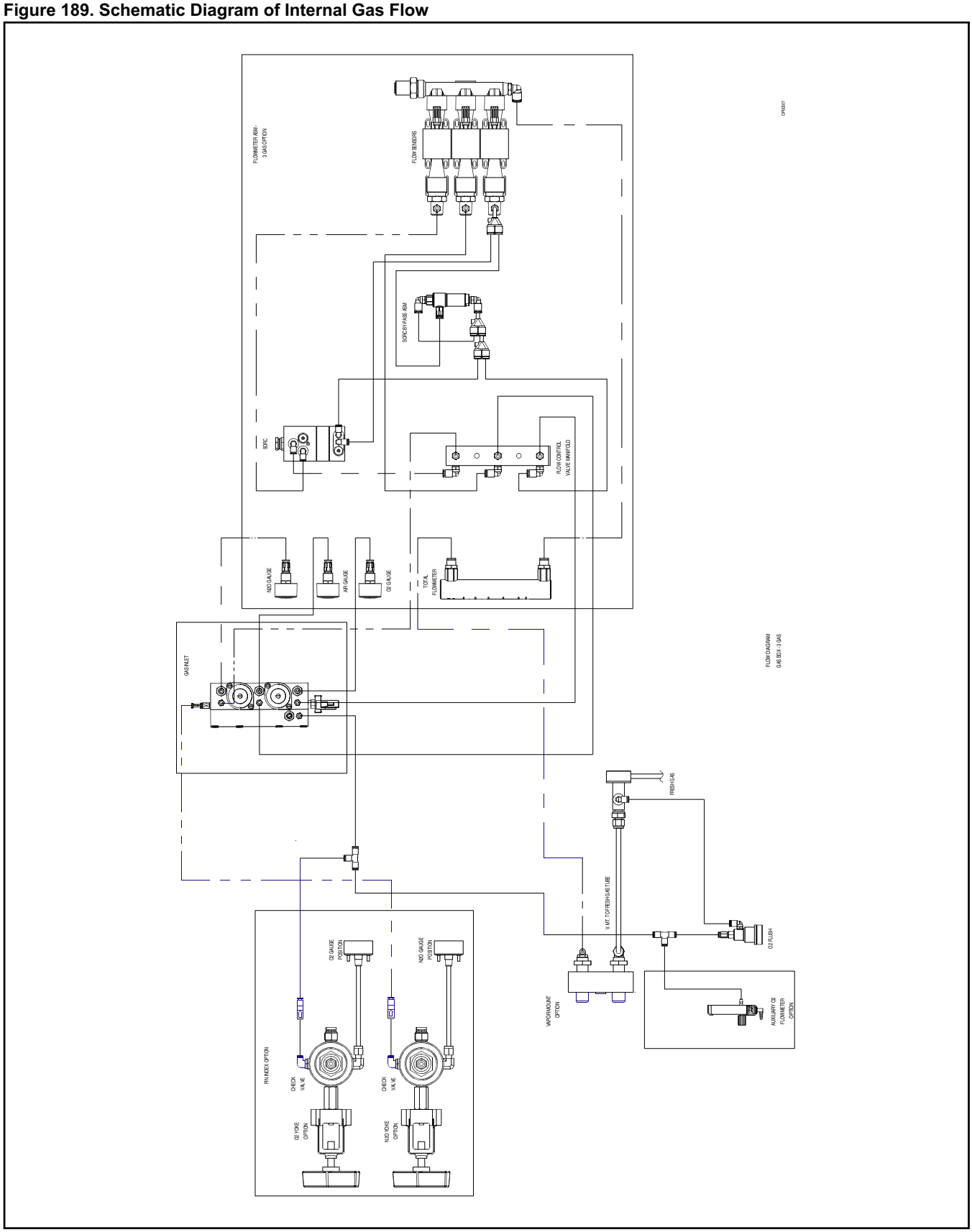


**Figure 189. Schematic Diagram of Internal Gas Flow**



# Daily and Preuse Checkout Form

Before operating the Fabius Tiro, the following checkout verification form must be completed to ensure that the machine is ready for use. Do not insert any additional components into or modify the anesthesia system after the checkout procedure is started.

This is a recommended procedure. Follow your institution's policies for specific checkout procedures.

**Caution:** If any check can not be carried out satisfactorily, the machine must not be used. Call DrägerService.

**Note:** Throughout this section, $cmH_2O$ = mbar = hPa

Please note that this Daily Pre-use check list takes into consideration all possible configurations of the Fabius Tiro. The clinician need only use those areas that apply to their specific Fabius Tiro configuration.

All checks must be carried out daily before equipment is used. The person who carries out the checks must be fully conversant with the Instruction for Use. Checks marked with a **P** must be carried out before each patient use. These pages should be removed and copied to establish a daily record of machines checks. Mark each function when checks have been satisfactorily completed.

**Fabius Tiro Serial Number** _____

### Pre-conditions

- ❒ Inspection intervals for machine and accessories are current
- **P** ❒ Machine fully assembled and connected
- ❒ Monitors ($O_2$, P, V, $CO_2$, anesthetic agent) (when present) switched on and functioning, self test carried out satisfactorily
- ❒ System diagnostics for Fabius Tiro carried out
- **P** ❒ Sampling line for gas monitoring (when present) connected to Luer lock on the Y-piece, correct anesthetic agent selected
- **P** ❒ Desflurane vaporizer (when being used) powered on

### Checking Reserve Power

- **P** ❒ Verify that battery is fully charged. (If the battery does not show full a charge, the battery operation time is not guaranteed to be 45 minutes.)

### Checking the Medical Gas Connections

- ❒ Visually inspect all gas supplies from the medical gas pipeline system and cylinders to make sure that they connect properly and fit securely.
- ❒ Verify that all medical gas pipeline supplies are within acceptable pressure ranges.
- ❒ Open reserve gas cylinders (when present).
- ❒ $O_2$ pressure more than 1000 psi (70 bar)
- ❒ $N_2O$ pressure greater than 600 psi (43 bar) if present
- ❒ Air pressure greater than 1000 psi (70 bar) if present
- ❒ Close reserve gas cylinders.

### $O_2$ Flush Function

- ❒ Press $O_2$ flush: A strong flow of gas should be emitted from the patient connection.
- ❒ Release $O_2$ flush button: flow of gas from patient connection stops.

### Checking the Flow Control/Metering System

- ❒ Activate ManSpont mode.
- ❒ Fully open the $O_2$ metering valve. $O_2$ flow of at least 10 L/min present.
- ❒ Fully open the $N_2O$ metering valve. $N_2O$ flow of at least 10 L/min present.
- ❒ Turn off the $O_2$ supply. Remove the $O_2$ connector and close the $O_2$ cylinder valve. The $O_2$ Low Supply Pressure Alarm LED is blinking. $N_2O$ does not flow.
- ❒ Restore the $O_2$ supply: $N_2O$ flow is present.

## Appendix – Daily and Preuse Checkout Form

**Checking the Flow Control/Metering System**

- ❒ Set $O_2$ metering valve to 1.5 L/min. $N_2O$ flow = 3 L/min to 5 L/min
- ❒ Close the $O_2$ metering valve: No $N_2O$ flow.
- ❒ Open the AIR flow control valve. Air flow of at least 10 L/min present.
- ❒ Close all metering valves.

**Sensor Calibration**

- ❒ Calibrate $O_2$ sensor
- ❒ Calibrate flow sensor

**Checking the Gas Type**

- ❒ Set the $O_2$ metering valve to approx. 3 L/min.
- ❒ Verify an $O_2$ concentration indication of approx. 100 vol.%.
- ❒ Close $O_2$ metering valve.

**Vapor 19.n, Vapor 2000**

- **P** ❒ Fastening; Latched down firmly and set vertically
- **P** ❒ Handwheel; In zero position and engaged
- **P** ❒ Filling level between min. and max.
- **P** ❒ Key-indexed filling system; Sealing key or pin inserted and closed tight. (when present) Filler opening locked shut.
- **P** ❒ Quik Fil or Funnel filling system; Locking screw tight (when present)

**Desflurane Vaporizer** (when present)

- **P** ❒ Fastening; Latched down firmly and set vertically
- **P** ❒ Handwheel; In zero position and engaged
- **P** ❒ Filling level between min. and max.
- **P** ❒ Operational light lit

**Selectatec®**

- **P** ❒ Fastening; Latched down firmly and set vertically
- **P** ❒ Handwheel; In zero position and engaged
- **P** ❒ Filling level between min. and max.

**Checking the Condition of $CO_2$ Absorbent**

- **P** ❒ Color change is no more than half the canister of $CO_2$ absorbent.

**Leak Testing the Compact Breathing System with Semi-Open Adapter (When Present)**

- ❒ Go to Standby and press the Leak Test soft key.
- ❒ Disconnect the fresh gas hose.
- ❒ Put the test adapter on the fresh gas hose and connect to the patient Y-piece.
- ❒ Occlude the semi-open exhaust port.
- ❒ Set the APL to 70 mbar.
- ❒ Set the $O_2$ metering valve to 0.25 L/min.
- ❒ With the $O_2$ flush, build up a pressure of 60 mbar.
- ❒ Airway pressure must rise or remain constant.

If the system fails, locate and correct any external leaks by performing the leak test of the compact breathing system and repeat this test. If necessary, call DrägerService.

**Leak Testing the Fresh Gas Circuit**

Test once without the vaporizer and once with each Dräger Vapor with the handwheel set to zero.

In the following checklist, please note that there are three boxes for each item to be checked.

Box A = Fabius Tiro, No Vaporizers

Box B = Fabius Tiro, Single Vaporizer

| | A | B | |
|---|---|---|---|
| P | ❒ | ❒ | Go to Standby and press the Leak Test soft key. Follow the instructions on the screen. |

If the system leaks (i.e. pressure drops):

- Check that all plug-in, push-fit and screw connectors fit tightly.
- Replace any missing or damaged seals. If necessary, call DrägerService.

## Appendix – Daily and Preuse Checkout Form

**Inspiratory and Expiratory Valves (Compact Breathing Systems)**

Press the ManSpont key and confirm.

Set APL-valve to MAN position and adjust to 30 mbar.

Press $O_2$ flush.

P ❒ Breathing bag for manual ventilation fills

P ❒ Inspiratory and expiratory valve discs move freely when the breathing bag is squeezed and released.

**APL Valve (Compact Breathing System)**

P ❒ Set APL valve to MAN and 30 mbar. Set fresh gas flow to 20 L/min.

P ❒ Press the ManSpont key and confirm.

P ❒ When the pressure waveform on the Breathing Pressure Trace window stabilizes (e.g., a flat line), flip the APL-valve to SPONT to release pressure.

P ❒ Peak pressure display on monitor reads 24 to 36 mbar.

**Heated Breathing System** (when present)

❒ Calibrate flow sensor.

❒ Check cable connections.

❒ Check power cord connections.

❒ Ensure that the MAINS POWER LED is illuminated.

❒ Ensure that the HEATER POWER switch is in the “ON” position.

❒ Ensure that the “HEATER POWER ON” LED is illuminated.

❒ Ensure that the underside of the COSY is warm (approximately 35-40°C) after 30 minutes have elapsed since the “HEATER POWER ON” LED was illuminated.

**Checking Ventilator Operation**

P ❒ Connect a breathing bag to the Y-piece to act as test lung.

P ❒ Press the Pressure Control key and confirm.

P ❒ Check that ventilation measurements are displayed.

P ❒ Check that the ventilator piston is cycling.

P ❒ Monitor the operation of the inspiratory and expiratory valve discs.

P ❒ Check that the breathing bag (test lung) on the Y-piece is ventilating.

P ❒ Press the Standby key and confirm.

**Monitors**

The alarm function can be tested by setting alarm limits to levels that are certain to trigger an alarm.

Check the alarm limit settings. The monitor alarm limits are automatically set to a default configuration when the SYSTEM POWER switch is turned on. Check these settings and adjust them if necessary. Alarm limits can be adjusted at the beginning of or during a procedure. Also, make sure that any external monitors (if any) are connected properly.

Test the alarm functions for all monitors. Simulate alarm conditions and check for appropriate alarm signals.

❒ Test the $O_2$ monitor and alarm module.

❒ Test the volume monitor and alarm module.

❒ Test the pressure monitor and alarm module.

❒ Press the Standby key and confirm.

**Additional Monitors** (when present)

❒ Check the $CO_2$ monitor and alarm module.

❒ Check the anesthetic agent monitor and alarm module.

**Anesthetic Gas Scavenging System**

P ❒ Check the hose connections.

P ❒ Adjust the flow regulator to place the float between the "Minimum" and "Maximum" marks.

P ❒ Press and hold the $O_2$ flush button and verify that airway pressure is < 10 mbar with Y-piece occluded.

P ❒ Close all flow control valves on the machine, with Y-piece occluded, and verify that airway pressure is > –0.5 mbar.

**Manual Ventilation Bag for Emergency Ventilation**

❒ Check that the bag is functioning correctly by pumping manually.

❒ When the bag is squeezed, air must audibly and tangibly flow out of the mask cone; when the bag is released, it must rapidly recover its original shape.

❒ Block off the mask connector (cone) with the ball of your thumb: you should only be able to squeeze the bag a little.

P ❒ **Before Connecting to Patient**

Verify that
- all vaporizers are off (the handwheels are set to zero),
- the APL Valve is set as desired,
- all flowmeters indicate 0,
- the patient suction is level adequate, and
- the breathing system is ready to use (the bag is in place and all hoses are connected properly)

**If any check can not be carried out satisfactorily, the machine must not be used.**

**Daily Checkout Signature**

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**Preuse Checkout Signature**

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## Appendix – Daily and Preuse Checkout Form

**Preuse Checkout Signature**

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These Instructions for Use apply only to
**Fabius Tiro**
with Serial No.:

If no Serial No. has been filled in by Dräger these Instructions for Use are provided for general information only and are not intended for use with any specific machine or device.

CE 0123

Directive 93/42/EEC
concerning Medical Devices

**Dräger Medical AG & Co. KG**
Germany
Moislinger Allee 53 – 55
D-23542 Lübeck
+49 451 8 82 - 0
FAX +49 451 8 82 - 20 80
http://www.draeger.com

**90 38 686** – GA 5330.610 en
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